# RECOMMENDATIONS.

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*Extract of a letter from Valentine Mott, M. D.*

From the examination which I have made of the work on Auscultation, which you have translated, I am happy to add my testimony of its value.

The brilliant results which have followed the discovery of the immortal Laennec, have created a new era in Medicine, and the improvements which have more recently been made by Louis, Bouillaud, and Piorry, entitle it to the support of all, who take an interest in the welfare and advancement of our profession.

Wishing the work every success,

I am truly your friend,

VALENTINE MOTT.

Dr. M. Post.

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*From J. Mather Smith, M. D. Prof. Theory and Practice of Physic in University State of New York.*

New York, 3d October, 1838.

*Dear Sir,*

I have been so much pleased with your translation of Raciborski's work on Auscultation and Percussion, that I do not hesitate to say to you, that I think its publication will be acceptable to the profession, and creditable to yourself. As a manual, it appears to me

extremely well suited to aid the student and junior practitioner, in acquiring a knowledge of the physical modes of diagnosis introduced by Avenbrugger and Laennec. The matter of the work is judiciously systematised and happily treated; and what, in my opinion, enhances its value, is the appendix of an extensive synoptical table, in which the signs of auscultation and percussion are so arranged as to exhibit, at a glance, their relations with the various forms and states of disease which they denote, and upon which they depend.

Hoping you will not delay the publication,

I am, dear Sir, respectfully,

Your ob't servant,

JOSEPH M. SMITH.

M. Post, M. D.

---

*From Dr. Horner, Prof. Anat. University of Pennsylvania.*

Philadelphia, Dec. 2d, 1838.

*Dear Sir,*

I have looked with much pleasure over your translation of Raciborski on Percussion and Auscultation, and so far as a hurried survey of its contents can justify an opinion, may say that it is a work of much merit, and is calculated to be extensively useful in the diagnostic of diseases to which those methods of exploration are applied. The style of the translation is in very good taste, and will no doubt redound to your credit. Should you, upon further consideration, deem any ideas of mine, on the texture of the lungs worthy a place in the contemplated edition, you will find them adequately represented in the second volume of my Special and General Anatomy, fourth edition. I have had no occasion to modify or retract those notions since their first annunciation, inasmuch as the researches of each year tend more and more to their confirmation, and a standing testimony of their truth exists in numerous preparations which are in the Anatomical Museum of the University.

I am, very sincerely, your friend, &c.

W. E. HORNER,
Prof. Anat. Univ. Pennsylvania.

Minturn Post, M. D.

## RECOMMENDATIONS.

*From John W. Francis, M. D. Formerly Prof. of Obstetrics in Rutger's Medical College, New York.*

NEW YORK, OCTOBER 25, 1838.

*Dear Sir,*

The Treatise of Dr. Raciborski on Auscultation and Percussion is a work of great merit and of eminent practical utility. The author manifests throughout a happy talent of observation, a lucid arrangement of his materials, and a strong conviction of the truth and importance of his deductions. The student will derive essential benefit from the perusal of the work; the experienced will be strengthened on many points heretofore too conjectural; and every one desirous of bringing to the bed side of the sick the most approved resources to establish the diagnosis of diseases, will derive essential aid from a knowledge of his commendable labours in the cause of inductive science. Your translation, I think, is entitled to high praise, and I feel persuaded your undertaking will confer much benefit on the profession.

I remain most truly your friend,

JOHN W. FRANCIS, M.D.

Dr. M. POST.

---

*From John C. Cheesman, M. D.*

NEW YORK, NOV. 3d, 1838.

*Dear Doctor,*

Agreeably to your request, I have devoted as much time as I could spare in looking over your translation of Raciborski's Elementary Treatise on Auscultation and Percussion, and believe, from the minute and lucid manner in which he has treated the subject, that your book will be of eminent advantage to our profession, and for which I hope you will be amply rewarded.

Very respectfully,

Your friend,

JOHN C. CHEESMAN.

M. POST, M. D.

## RECOMMENDATIONS.

*From Samuel Jackson, M. D. Prof. Institutes of Med. University of Pennsylvania.*

PHILADELPHIA, DEC. 21, 1838.

DR. MINTURN POST,

*Dear Sir*—The investigation of diseases by their physical signs, has become one of the established and most important departments of diagnostics.

It is expected that every physician should at least be familiar with the methods of physical examination, and what is to be determined by them, though he may not have acquired tact from want of sufficient opportunity, in detecting the obscure and delicate symptoms revealed only by these methods.

The publication of every work directing attention to these inquiries and spreading them before the profession, is of utility.

In looking over work which you have translated, I find the matters it treats of well arranged, and it appears to embrace all the subjects connected with this branch of medical investigation.

Respectfully yours, &c.

SAMUEL JACKSON, M. D.

# EXPLANATION OF THE PLATE.

FIG. 1. (A. B.)—*The Stethoscope as now in use, being a modification of the two forms proposed by Laennec.*

"In this modification, the *extremity* only of the plug (B. *c.*) and consequently its containing cavity, are made conical, according to the first form of Laennec, while a portion is left of equal diameter (B. *b.*) to enable it to retain its hold, without the brass tube.

A. The whole instrument with the two portions adjusted and the plug infixed, drawn so as to exhibit both its exterior and interior configuration. (The figure in the plate is not drawn of the exact proportions of the instrument, being only about *one-fourth* of its length, while it is *one-third* of its diameter.) *a.* The plug in its place. *b.* The upper half of the instrument. *c. c.* Rims of ivory or horn surrounding the pecto extremities of either half: *d.* A. cap of the same material surrounding and covering the whole auricular extremity of the instrument. *e.* The central bone.

B. The stopper (constructed to fit either the upper or lower half of the instrument) removed. *a.* Portion exterior to the funelled cavity when the plug is in its place, of the same diameter as the stethoscope. *b.* Outer portion of the plug, of equal diameter throughout. *c.* Conical portion of the plug."

FIG. 2. (A. B. C. D. E.)—*Piorry's Stethoscope and Pleximeter.*

"This *stethoscope* is constructed exactly on the same principles as that of Laennec, but with several modifications, intended to render it lighter, smaller, and more portable. In it the central bore and conical cavity of the pectoral extremity, are preserved of the original dimensions, but the body of the instrument is greatly reduced in size, and the proper width is given to the auricular extremity by screwing a thin ivory cap to the slender body of the instrument. The *pleximeter* is attached to the stethoscope merely with a view to render the former conveniently portable.

A. The whole stethoscope with the plug included, and the pleximeter attached, as carried in the pocket.

*a.* The body of the instrument, of one-fourth the actual size.

*b.* Its auricular extremity of ivory, and with a screw for attaching it to the auricular cap D.

*c.* Its pectoral extremity.

*d.* The pleximeter, of ivory, screwed upon the body of the stethoscope, and shutting in the plug E.

*e.* The auricular cap D. screwed upon the pleximeter.

B. An additional portion of cylinder fitted to screw on A. at b., for the purpose of lengthening the instrument, when one of a greater length is preferred.

## EXPLANATION OF THE PLATE.

C. The stethoscope fitted for use, the pleximeter being removed and the auricular cap (D.) applied. *a.* Auricular cap screwed upon the cylinder. *b.* The pectoral extremity freed from pleximeter and cap.

D. The auricular cap removed, interior view.

E. The plug or stopper removed."

FIG. 3. *b.—Pleximeter*, (*not connected with the Stethoscope.*)

This instrument is made of ivory. The bottom or central depression, is covered with sheepskin, in order to prevent the fingers from sliding, or producing any sound that might mask that elicited from the organ percussed.

FIG. 4. *a. a.—Piorry's Pleximeter* (*connected with the Stethoscope*)

with opposite elevations of the border, by which it is held, and an internal screw which attaches it to the extremity of the Stethoscope.

# PLATE

Fig 2.

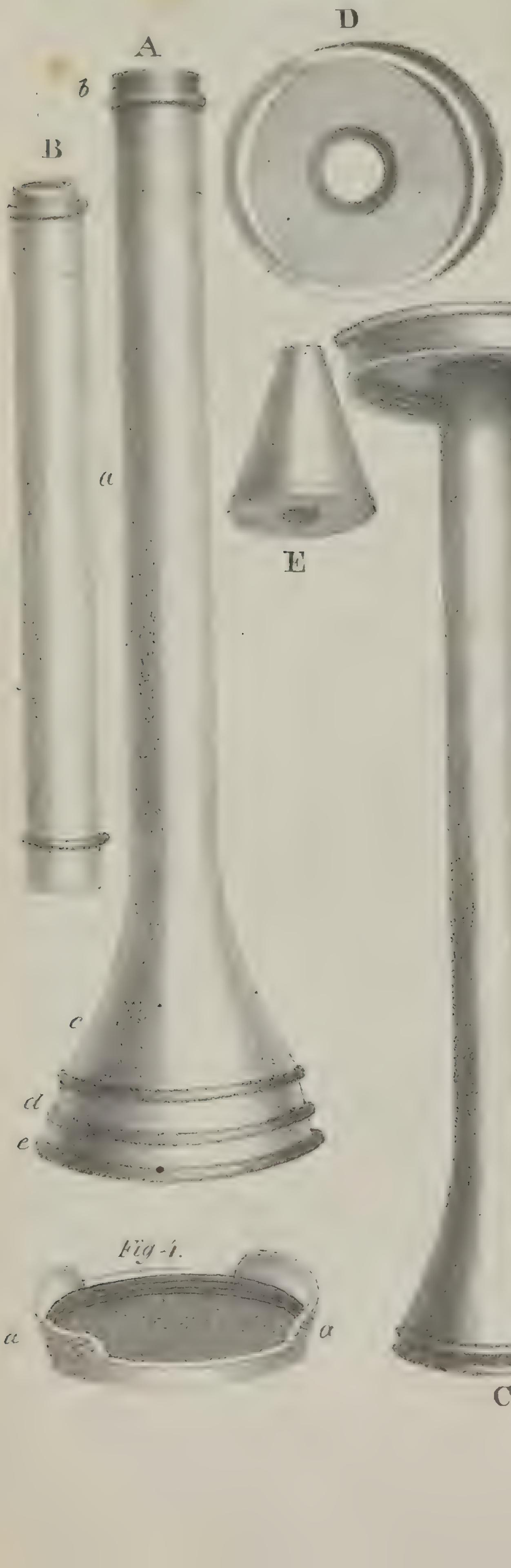


Fig 1.

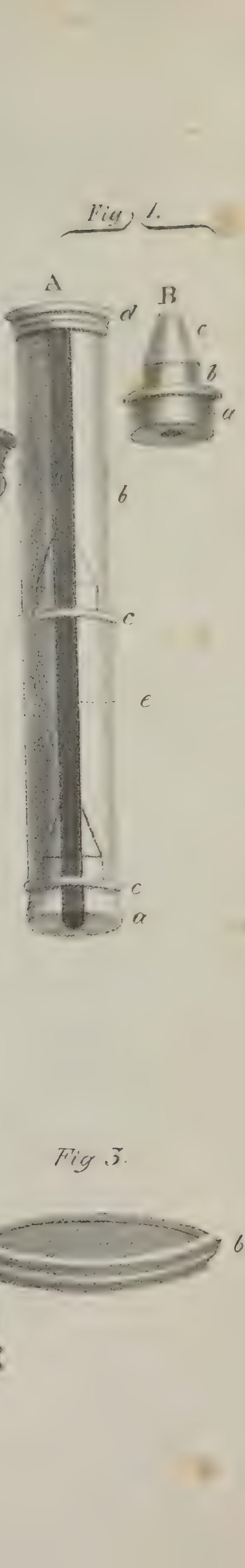


Fig 3.




Fig 4.

AN

# ELEMENTARY TREATISE

ON

# AUSCULTATION AND PERCUSSION;

OR, THE

# APPLICATION OF ACOUSTICS

TO THE

# DIAGNOSIS OF DISEASES,

WITH A

# SYNOPTICAL TABLE.


By A. RACIBORSKI, M. D.

OF THE FACULTY OF PARIS, FORMERLY SURGEON IN THE POLISH ARMY, PROFESSOR OF MEDICINE, CHEVALIER OF THE ORDER OF THE GOLDEN CROSS OF POLAND, &c.

TRANSLATED, WITH NOTES, &c.

By MINTURN POST, M. D.



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TO

# SAMUEL JACKSON, M. D.

PROFESSOR OF THE INSTITUTES OF MEDICINE IN THE
UNIVERSITY OF PENNSYLVANIA,

THIS TRANSLATION IS

INSCRIBED,

AS A SLIGHT TRIBUTE OF RESPECT

FOR THE

TALENTS, AND INDUSTY,

WHICH HAVE

CONTRIBUTED SO MUCH TO ELEVATE THE

PROFESSION TO WHICH THEY HAVE BEEN DEVOTED,

AND FOR THE

MANY ACTS OF PERSONAL KINDNESS RECEIVED

BY HIS OBLIGED FRIEND

THE TRANSLATOR.

# TRANSLATOR'S PREFACE.

---

The acknowledged importance which is at the present day conceded to the discovery of the justly celebrated Laennec, and the great interest which the medical practitioner has, in availing himself of the labours of those whose extensive opportunities, have enabled them to unfold the mysteries of physical diagnosis, are the chief motives which have induced the present translation.

In a country in which the various affections of the chest, constitute so large a portion of the diseases incident to the climate, and where epidemic influences frequently determine changes of the gravest character, it is essential that the physician should be possessed of all the means, capable of throwing light upon the obscure and difficult cases committed to his care.

It is on this account, that Auscultation and Percussion have the highest claim to the consideration of the members of our profession, in enabling them to detect and properly to estimate, the various signs elicited by this mode of physical examination.

Our author has diligently collected, into a systematic compendium, the various contributions that have been made to this branch of medical science, and by his lucid arrangement has added perspicuity to the facts which he has detailed, and clearness to the method which he has adopted.

For faults, whether of manner or style, the translator claims the indulgence which is due to the difference of idiom, and the inherent difficulty which exists in giving an author's ideas in the garb of another language.

*New York, June* 12*th*, 1839.

# CONTENTS.

# UTILITY

OF

# AUSCULTATION AND PERCUSSION.

---

Auscultation and Percussion are nothing more, than the application of the sense of hearing, to the diagnosis of diseases. These two methods, although very distinct, offer, however, so many points of resemblance and analogy in their practice, their application, and their natural dependence, that we have considered it unnecessary to treat of them separately.

Auscultation has for its object, the discovery of the different sounds which occur during the vital action of the various organs of the body; but its application is generally confined to those of the respiration and circulation.

Being previously instructed by repeated observations, (observations based upon the general laws of physics,) that a particular sound observed in an organ, corresponds to a known pathological condition, we can easily recognise by the aid of auscultation the seat and nature of the affec-

tions which modify the functional sounds. For instance, the physician who is instructed by the results of experience, is well aware that the crepitous rattle, indicates the existence of pneumonia in its first stage, or an alteration in the condition of the pulmonary vesicles: again, that the sibilous rattle, or ronchus, denotes the existence of catarrh, or a change from the normal condition, having its seat in the bronchial tubes.

Percussion consists in shocks made principally by means of the fingers on the regions of the body; it causes them to render different sounds, according to their nature and the various conditions of the organs. The field of its application is much more extended than that of auscultation.

The latter, in fact, can be applied to those organs only, which produce spontaneous sounds, whilst the former may be practised over the whole region of the body: for practical purposes however, its application is generally confined to the walls of the great cavities of the trunk. If a region, which in its healthy state renders a clear sound, becomes dull and obscure when percussed, it is evident that the abnormal sign thus presented to our notice, indicates the existence of a morbid affection in the organ, corresponding to the region examined.

It will therefore be easy to ascertain to which

of the different organs this condition belongs, by recalling the positions which they occupy in their several regions. Thus percussion will become a valuable means of determining, in a precise manner, the variations, whether of situation or volume, of which the organs of the body are susceptible. For instance, it is well known that the inferior portion of the right hypochondriac region, situated immediately under the border of the false ribs, when percussed in a healthy state, gives a *clear sound;* if however, this region render a *dull sound*, we are at once made acquainted with the existence of a morbid condition, although its immediate seat is not yet determined: if the *dullness* or *obscurity* of sound be prolonged upwards in the direction of the liver, while it ceases inferiorly, we should be informed that the organ was in a state of hypertrophy, and that it extended beyond the border of the false ribs: if in place of ascending, the *obscurity* or *flatness* descend without interruption to the region of the right ovary, we should say that it depended upon a tumour situated in the latter organ.

Even though auscultation and percussion had produced no other result, than that of having contributed so much to our knowledge of the diseases of the respiratory organs, which it has exhibited under an aspect as true as novel, the service rendered to the profession were invalua-

ble. In fact, what uncertainty and error prevailed in the diagnosis of diseases of the chest, anterior to the improvements in the different modes of percussion and the discovery of auscultation! It is well known that the existence of large quantities of intestinal gas, by causing the diaphragm to encroach upon the lungs, will create considerable dyspnœa: in this case the oppression and difficulty of breathing, were supposed by the ancients to depend upon a particular lesion of the respiratory organs, to which, modified by the circumstances of the case, the term Pleurisy or Peripneumony was applied.

At this period, when the existence of pneumonia was established by dyspnœa and bloody expectoration only, true affections of the lungs often escaped notice, or were taken for morbid states, altogether foreign to their real condition. For instance, it frequently happens that in aged persons, inflammation of the lungs is unaccompanied with expectoration, though attended with that prostration of the forces, which is common to all the severe affections which affect them: in these cases the term adynamic fever was had recourse to, in order to explain the different signs which in reality constituted pneumonia.

Such was the state of medicine at the latter part of the last century, and even at the commencement of our own. The affection which

Stoll described under the name of *bilious pleurisy* or *peripneumony*, was nothing more, as has been well remarked by Pinel, than gastric derangement complicated with bronchitis. There are indeed many cases in the clinical observations of Pinel himself, described as adynamic fevers, which at the present day would be recognised as true inflammations of the lungs.

The prognosis could not be more correctly established than the diagnosis, for although in the absence of positive indications, all the changes which supervened in the course of the disease were scrupulously observed, such as the pulse, the urine, the alvine evacuations—in fine, all the circumstances from which an opinion could be drawn, as to the probable termination of the affection, still, signs so incomplete, so variable and inconstant, could not supply the place of a correct diagnosis, and could not free the prognosis from the incalculable dangers of inaccuracy and error.

At the present day, when our art possesses the means of establishing positive diagnosis by harmonizing with the exact sciences, the prognosis reposes essentially upon the diagnosis, of which it is merely the correct interpretation. This once established, nothing is more easy than to prognosticate, according to the gravity of the malady and the importance of the organ affected. As

an instance of the simplicity of the prognosis, even in reference to diseases of the respiratory organs, take for example, two patients, one of whom has a small portion of one lung inflamed in the first degree, the other has the whole lung hepatized; it will follow that the latter is in by far the more dangerous situation: here we have at once the prognosis simple and evident, or a correct interpretation of the diagnosis. If then it be to auscultation and percussion that we are indebted for a knowledge of the diagnosis, it is also to them that we owe the establishment of a rational prognosis. The same difficulties and the same errors which we have noticed in reference to the prognosis and diagnosis of diseases, were necessarily encountered in the treatment; hence the most terrible and irreparable consequences frequently followed, from misguided or inefficient means. Pneumonia being considered an adynamic fever, it was the practice to commence by the exhibition of stimulants, as *camphor*, *Virginia snake root*, *acetate* of *ammonia*, &c. These excitants, instead of elevating the forces of the patients, hastened only their death, whilst venesection, by acting directly against the morbid lesion, would have added to their strength. The entire absence of positive signs complicated in a great degree, the difficulties of the treatment; even the resources of the expectant method,

were denied to the practitioner, involving the whole case in uncertainty and doubt. It is under these circumstances that auscultation and percussion afford us so much assistance, either to change an injudicious treatment, to continue that which is suitable, or to modify and adapt it to the actual condition of the disease. Nor were there more correct data in establishing the cure; for as no one ever supposed the existence of pneumonia, unless dyspnœa and bloody expectoration existed simultaneously, affections which ceased to offer these characters were considered cured. How many persons have been the victims of this error! how many cases do we not see at the present day, in which there is no difficulty in the respiration, in which the expectoration is either natural in appearance, or has entirely disappeared, but in which the germ of disease still lurks! If patients whose cases are analogous to the above, are discharged as being cured, and are allowed to adopt the regimen of persons in health, and to commit excesses, the morbid action instantly springs up, and instead of being extinguished, takes on a chronic state, which is arrested only at the grave.

We have more than once seen at the hospital de la Charité, in the service of Professor Bouillaud, patients affected with pneumonia, who have informed us, that at the invasion of the disease,

they had been bled previously to entering the hospital, and that the painful symptoms having disappeared, the physician had supposed them cured, and had discharged them, when suddenly, at the end of two days, they began to expectorate blood, again to experience difficulty of breathing, and to be affected with cough. Such is the cause of the greater number of consumptions, which, whatever may be said to the contrary, are nothing more than chronic inflammations, which may however, be primitive or succeed cases of pneumonia and bronchitis, that have been improperly treated or imperfectly cured.*

It was in consequence of having neglected to examine the patients, by auscultation and percussion, that these errors were committed; because, had the state of the respiratory organs been investigated after the first bleeding, the treatment which had already mitigated the severity of the disease, would have been pursued with vigour. Auscultation and percussion, seizing upon the

* The weight of medical testimony upon this interesting question, seems at the present day to be in opposition to the opinion here enforced. Recent researches upon this subject prove, that in the great majority of cases of Phthisis Pulmonalis, inflammation is not of itself sufficient to produce tubercular deposit. For more particular information on the subject, the reader is referred to the very able work of M. Louis, entitled Recherches Anatomico-Pathologiques sur la Phthsie, page 523.—(*Transl.*)

least vestiges of the pathological condition, enables the practitioner to extinguish the disease by the same means, that controled it at the onset.

Every thing then, in relation to the affections of the lungs, was either unknown or misunderstood, before the lights of auscultation and percussion were cast upon these investigations. It was in consequence of the great ignorance, which prevailed formerly upon these subjects, that tubercles were often confounded with chronic catarrh; hence certain physicians, enjoyed the exclusive privilege of curing phthisis pulmonalis; but in how many instances was their ephemeral reputation destroyed by their failures! At the present day, ignorance and error have given place to the exact sciences. It is true that we too often discover, how impotent, are all efforts in staying the march of this terrible malady; still the cases of success, though few in number, are nevertheless proved to be authentic.* The great advantage which results from the introduction of these

* The observations of Laennec, upon the cicatrization of tuberculous excavations in the lungs, have more recently been confirmed by Audral, although the cases in which it occurs, are not necessarily to be regarded as cured, since dissection has revealed the fact, that while cicatrization has filled up one cavity, others have existed, filled with tuberculous matter, communicating with a bronchus and presenting all the ordinary phenomena of vomicæ. The instances of cure, must therefore be restricted to those cases, in which a single cavity has existed, without the remaining portion of the lung, being affected by the tubercular diathesis.—(*Transl.*)

auxiliaries into our science, is, that we no longer subject our patients to a blind groping in the dark, but to a treatment the success of which can be proved with mathematical certainty.

Let us now examine into the effect, produced by the result of these discoveries in relation to diseases of the heart. It is to auscultation and percussion, conjoined to the labors of the modern anatomo-pathologists, that is due the analysis of the different affections, formerly comprised under the general name of *asthma*.

At present, we distinguish under this appellation, sometimes lesions of the heart, sometimes of the pericardium, and at other times of the pleura and lungs. It is by the aid afforded by these two methods, that many modern writers, among whom M. Bouillard stands conspicuous, have been enabled, to discover in the centre of the circulation, the true nature of a variety of affections, which were formerly supposed to depend, merely upon active and passive aneurism. (*Corvisart.*)

These progressive steps are far from being illusory; they modify the treatment, and bespeak their recommendation, in the success which has followed their adoption.

The opinion, that the diagnosis of the diseases of the heart, is of little consequence, since there is but little variation in the treatment, is entirely

erroneous, inasmuch as there are some affections of this organ, in which, instead of employing venesection, it is necessary to have recourse to the preparations of iron and quinine. The same remarks are applicable, in reference to diseases of the respiratory organs.

The application of physical signs, to the diagnosis of these affections, will afford us positive indications, by which we will be enabled to watch the progress of the case, as well as to estimate with certainty, the value and effect of the treatment.

It was by pursuing his investigations, in the manner here indicated, that the practitioner above alluded to, discovered some years since, that the peculiar sound denominated by him, *bruit de diable*, (which had been said by Laennec to exist in many arteries), occurs constantly in the carotids of chlorotic patients.

This sign being the uniform attendant of chlorosis, and exsanguined states of the system, has become a valuable assistant in directing the treatment of these affections.*

* The occurrence of this sound, uniformly denotes an impoverished state of the system, hence its existence will become an important therapeutic sign, in determining the course of treatment to be pursued in cases, where apparent plethora, might otherwise lead to copious and perhaps fatal depletion.

The change of sound in the arteries caused by the pressure of various tumours, is also of great practical utility in detecting their exist-

How great an improvement have we derived from this mode of exploration, in the examination of diseases of the abdomen! How often has pain in the region of the epigastrium, been considered pathognomonic of gastritis, when mediate percussion has discovered its seat to be in the left lobe of the liver! How many cases of pleuritic effusion of the right side, has it not shown to depend upon hypertrophy of this organ!

Lastly, one of the most useful applications of this method to diagnosis, is the assistance which it gives us in determining the existence of pregnancy.

It is well known that the movements of the fœtus, regarded as being the most certain sign of its existence, are at times entirely wanting; at other times, hysterical women confidently believe themselves to be in a state of utero-gestation: in these cases auscultation, by seizing upon the difference of sound, between the heart, the fœtus, and the placenta, will at once dispel all doubt from our minds.

Nor is surgery without its benefit from auscultation; the crepitation of fractured bones is rendered very distinct, by applying the ear immediately over the part. Again, in determining

ence; as, for instance, in the case of a tumour in one of the ovaria compressing either of the iliac arteries.—(*Transl.*)

the existence of calculus in the bladder, the vibration communicated through the parietes of the hypogastrium, may be depended upon, as being more accurate than the sensation of resistance, which the calculus opposes to the shocks of the sound.

We cannot close this general sketch without remarking, that the whole range of medical science has gained immeasurably by the introduction of auscultation and percussion.

Who can affirm that those cases cited by the ancients, as examples of essential and inflammatory fevers, were not latent or obscure affections of the lungs and circulatory centre ?

# PART FIRST.

## EXPLANATION OF THE DIFFERENT SIGNS DERIVED FROM PERCUSSION AND AUSCULTATION.

## SECTION I.

## PERCUSSION.

### CHAPTER I.

#### OF PERCUSSION IN GENERAL.

Percussion is executed, as we have already remarked, by striking principally with the fingers, upon the different regions of the body. It has for its object, the discovery of the state of the organs, by the different sounds which it causes them to render, and also their size, form, consistence, and density.*

It is to Avenbrugger, a physician of Vienna, that is due the merit of having introduced this method of examination into medicine. It was

* Certain practitioners, at the head of whom stands M. Piorry, have become the exclusive advocates of Percussion; but, in the opinion of the most celebrated pathologists of the present day, in most cases it is only when it is joined with auscultation, that percussion becomes so pre-eminently useful, in affording collateral testimony, by corroborating the various signs furnished by the latter.—(*Transl.*)

entirely unknown to the ancients, and richly deserves the title of novum inventum, given to it by its author. The first work of Avenbrugger on this subject, appeared at Vienna in 1761. Shortly after, in 1770, it was translated into French by Rozière de la Chassagne, who published it, as an appendix to his work on the diseases of the lungs. It has been observed by Corvisart however, that at the time when he commenced his medical studies, both the name of Avenbrugger and his discovery had remained entirely unknown. Stoll alone, of all the authors who wrote after the discovery of percussion, availed himself of it with advantage. Rozière de la Chassagne, candidly avows that he had never employed it.

No longer than fifty years after this period, Corvisart, having read the works of Stoll, had the curiosity to test the reality of the discovery; he became entirely convinced of its great importance, and proclaimed it to be indispensable to the correct diagnosis and treatment of diseases.

Having thus brought to light a discovery, which had been so long forgotten, or rather unknown even to the countrymen of Avenbrugger, he might have laid claim, had he been so disposed, to the credit of the invention; but with as much diffidence as learning, he contented himself with the merit of having rendered immense service to the

diagnosis of the diseases of the chest, and in a translation of the works of Avenbrugger, renders ample justice to his talent as an observer, and his inventive genius as a physician.

Percussion, as employed by Avenbrugger, was applied only to the organs contained within the thorax. His method consisted in slow and gentle percussion, executed directly upon the walls of the chest, with the extremities of the fingers joined together and elongated.

In order to avoid the confusion of the true sound of the organs, with the noise produced by the collision of the fingers against the naked walls of the chest, Avenbrugger advises us to wear a glove, and always to avoid striking the parieties of the thorax, unless they be covered.

Corvisart percussed with the plane of several fingers united together. Laennec used the stethoscope for this purpose.

Whatever may be the manner of practising immediate percussion, it offers however, many inherent disadvantages, some in reference to the mode of its application, and others in regard to peculiarities of organization and disease. In the first place, it is impossible, whatever may be said to the contrary by Avenbrugger, that definite sounds can be obtained by immediate percussion, without causing great pain to the patient; add to this, the difficulty of comparing sounds which dif-

fer according to the sides of the trunk, whence they proceed, and the impossibility of fixing in a precise manner, the limits of lesions of small extent. Secondly, certain regions, as the scapular, subscapular, and mammary, offer great difficulties to this mode of examination, while in cases of obesity, anasarca, and œdema, it would be entirely impracticable. Again, should it be attempted at periods when the surface to be percussed, was covered by a blister, or an exanthema, the sufferings of the patient would of course be very severe. The greatest objection to it, however, is, that it cannot be applied to the exploration of the abdomen. In fact, the soft walls of this cavity, do not produce vibrations sufficiently distinct, to enable us to appreciate the state of even the superficial organs, and consequently can be of no assistance in the formation of an opinion upon the condition of those deeply seated.

In consequence of these imperfections, this method is no longer used in the examination of diseases of the abdomen, with the solitary exception, that in certain cases of tympanitis, it is occasionally employed to ascertain the extent of the disease.

Since the new impetus which Laennec has given to medicine, by a happy application of acoustics to the diagnosis of diseases, physicians have better understood the relation between ex-

ternal physical signs, and the condition of the organs within, and have long been satisfied of the imperfect nature of immediate percussion.

The property which certain solids, when in a state of vibration, have, of propagating it to those bodies with which they are in contact, suggested to M. Piorry, the idea of mediate percussion. This method of exploration, consists in striking a plate of solid or elastic material, over any region of the body, in such manner as to develope sonorous vibrations, which, extending to the subjacent organs, are changed to the sounds peculiar to them.

The term pleximeter (*πλησσω I strike* or *πληξις percussion*, and *μετρον measure*) has been applied by M. Piorry to the body which transmits the sonorous vibrations. It consists of a circular piece of deal wood of a line in thickness, and two inches in diameter, with two small projections at opposite sides of the circumference. This instrument has however, undergone many modifications, as well in reference to its composition, as its form; those most in use at present, are made of ivory or gum-elastic; the latter being introduced by M. Louis; they are superseded, however, in general, by the fore finger of the left hand. Public opinion is the best test in reference to the relative value of these instruments. The caoutchouc when percussed, al-

ways gives a particular sound resulting from its elasticity, which obscures that of the organs; it is in consequence not much employed, except by the practitioner who introduced it.

Physicians are at present divided in their choice, between the ivory pleximeter and the finger. The former is nothing more than a circular plate, with two smooth surfaces, the superior being edged with a border either continued around the whole circumference, or elevated at two opposite points only.* In our opinion, the finger, composed of bone and soft parts, unites every advantage. The best will in all cases, be that to which we are most accustomed; though it is preferable to use alternately one or the other, according to the circumstances of the case.

If it become necessary to percuss the chest of a thin subject, the finger will be found to apply itself much better than the pleximeter, to the intercostal spaces; it should also be preferred in examinations of that part of the lung which is situated above the clavicle.† In all other cases,

* M. Piorry has lately introduced the graduated pleximeter, which, however, is nothing more than the ordinary one now in use, with lines marked upon the upper surface, which enables him to determine with greater accuracy, the limits of the organs to be examined.—(*Transl.*)

† In percussing, either the palmer or dorsal surface of the finger may be used: when the former, the sound is found to be clearer, though accompanied by a slight clacking noise. In the exploration of the supra-clavicular region, most persons prefer the use of the palmer

the ivory pleximeter will offer greater advantages than the finger; indeed, in explorations of the abdomen, it is absolutely indispensable, since the soft parts of the finger absorb the sound, already rendered obscure by the thickness of the parietes.

The pleximeter should be held between the index finger, and the thumb of the left hand, in such manner, as to admit of no sliding or change of position, and should be applied directly over the part intended to be examined. Great care is requisite, in applying the instrument: firstly, it is necessary that it should be pressed closely to the part; secondly, there should exist no space between the instrument, and the region to be examined. These are two essential conditions, without which, the results of percussion will be fallacious.

The pleximeter, should in general be applied directly to the skin; the presence however, of light bed-linen, a shirt, or underjacket, will not sensibly affect the sound, provided the material be not knit or woollen, since, in this case, the same inconvenience would be experienced, as before noticed in reference to its negligent application.

surface, as the curve of the finger adapts itself better to the concavity of the part.—(*Transl.*)

In percussing, the index and middle fingers of the right hand, are united, the thumb being arched against the former, which, in its turn, presses against the medius: the extremities of the fingers, should not project beyond each other, neither should the nails be salient. The index and medius thus disposed, and held obliquely, in such manner as to allow the pulp only, which tips the ends of the fingers, to touch the instrument, should strike it in general with gentleness.

The stroke should be dry; to produce which, the fingers should be instantly withdrawn, when the shock is given, in order to permit re-action; it should also be rapid, that the vibrations may be sonorous. The same remarks are applicable to percussion with the finger, which, when adopted, should always be upon the same phalanx, and the fingers which percuss, should always preserve the same angle with that which is struck; this rule should also be observed in the preceding case. If the finger be selected instead of the pleximeter, the second phalanx of the index of the left hand, is that which is preferred.

We have nothing farther to remark in this exposition of the general rules, which relate to the application of percussion, unless it be to add the injunction, that it be executed with the greatest possible uniformity, a circumstance of the

greatest importance, especially in comparative explorations.

The degree of force to be used when percussing, will of course vary according to the density of the regions examined, the state of embonpoint, and the strength of the patient.

If these rules be strictly followed, the different regions of the body will afford sounds of a very marked and varied character; they have been arranged by M. Piorry into the following scale.

| | | |
|---|---|---|
| Femoral | Corresponding to the percussion of the | Thigh. |
| Jecoral | | Liver. |
| Cardial | | Heart. |
| Pulmonal | | Lungs. |
| Intestinal | | Intestines. |
| Stomacal | | Stomach. |
| Osteal | | Bones. |
| Humorique | | Organs filled with air or fluid. |
| Hydatique | | Tumour composed of hydatids. |
| In order to complete the table, we will add the sound of a *cracked vessel*, which should not be confounded with the humorique. | | Cavern filled with air, having a narrow aperture at its outlet. |

The first six of these gradations are referable to two principal kinds of sound: they are divided between the *flat* or *dull*, and the *clear*; and these two definite terms designate, according to circumstances, all the different variations; the sound being of a more marked character, when it proceeds from organs which are hollow, and less so, when elicited from those that are solid.

The last four degrees of the scale, have a character peculiar to themselves, which it is proper to distinguish from the first six: they differ as much in their composition, as in their sounds. The first of these four gradations, is produced by the percussion of organs which are very hard and naturally sonorous, as bone. The three following, though seated in organs which are in an abnormal condition, do not represent, properly, the sound of these organs. On this account, the term *bruit* (noises), has been applied to them. The humorique or hydropneumatic sound, exists occasionally in the healthy state.

If a region renders a *clear sound*, when percussed, it is a sign that the organ or organs contained within it, are filled with air, and the resonance will be in proportion to the quantity of the elastic fluid: thus the lungs, which contain air within their vesicles, will give *the clear sound* (pulmonal;) the stomach, which contains a great

quantity of gas, will also render *the clear sound* (stomacal), though more distinct, having a close resemblance to that of a drum, whence the term tympanitis is derived; precisely the same is observed of the intestinal sound.

All organs which are solid, or whose walls are thick, will give the *flat* or *dull sound* when percussed, being modified however, by their density and structure: thus, the heart will afford this character, though less marked than that of the liver, still less so than the thigh. Independent of the difference of sound obtained by percussion, the sensation of passive resistance, which is experienced by the fingers, is exceedingly important as a pathognomonic indication: for instance, if the liver be percussed in two persons, in one of whom it is healthy, and in the other, filled with scirrhous masses, the *flat* or *dull sound* peculiar to the organ, will in the case of the latter, be accompanied with a much greater degree of resistance. It is important to know, that the practical distinction, either of sounds or resistance, in the natural, or in the abnormal state, is drawn less from its absolute character, than from a comparison instituted between the signs, furnished by the different organs of the body.

# CHAPTER II.

## PERCUSSION OF THE THORAX.

### *Normal Condition.*

The exploration of the trunk, is made in reference rather to its osteological than splanchnological division; it is therefore under the first of these, that the subject is treated in the following chapter.

The space comprised within the trunk is divided into two parts by the diaphragm. In the portion which is situated above this partition, the lungs, heart, and great vessels, are offered to our consideration; in the inferior, are placed the liver, spleen, and stomach.

Before entering upon the details of the subject, it will perhaps be better, that we recall a few anatomical facts. It will be recollected, that the diaphragm, stretching like an arch, from one side of the thorax to the other, is directed obliquely upwards, from the second and third false ribs posteriorly, to the sixth and seventh anteriorly, separating completely the two great cavities of the trunk. It is exceedingly important to remember this disposition, in order to recognise, when exploring, that of the subjacent parts. The right half of the thoracic

cavity, corresponds to the right lung; the left answers to the left lung, and in addition to the heart, there are also the great vessels situated along the median line.

The left lung being smaller than the right, and being encroached upon by the heart, covers only the external part of the anterior portion of the diaphragm. The other portion corresponds to the heart, which is placed a little to the left of the median line, and is contained between the fifth and seventh rib.

The anterior border of the lung, is much shorter than the posterior, and descends only to the sixth rib from the supra-clavicular depression, which corresponds to the summit of the lungs, and limits the anterior portion of the thorax. The posterior border of the lungs, thicker than the anterior, stretches, on the contrary, from the corresponding supra-spinous fossa, which marks the posterior summit of the lung, to the second and third false ribs, by an expansion, which becomes thinner as it approaches the vertebral column.

In that portion of the right side, which is situated under the diaphragm, the superior part of the liver, is limited by the transverse direction of the partition. The superior surface of this convex organ, as also the concavities of the diaphragm and right lung, are so well overlapped

by each other, that the posterior border of the latter, corresponds nearly to the inferior edge of the liver. The anterior border of this latter surface, is nearly even with the edge of the right false ribs, and limits inferiorly, the right half of the bony thorax. Towards the median line of the sternum, in the angle formed by the approximation of the cartilages of the false ribs, (*epigastrium*), exist the cardiac and pyloric portions of the stomach, the body and cul-de-sac of which, being directed to the left, occupy in great measure, the sub-diaphragmatic region of this part of the thorax. The inferior and external portions of the left side of this region, are filled by the spleen, which answers to the false ribs. These two latter organs, in connection with the left false ribs, limit the inferior half of this side of the thorax.

In having devoted ourselves, to explain the various degrees of sonorousness, in organs of different structure, we have already solved the following problem: the structure of an organ being given, to determine its sonorousness. In applying these general data to the thoracic viscera, with the composition of which, we are well acquainted, we at once perceive, that in the normal state, that portion of the thoracic parietes, which answers to the lungs, (organs filled with air,) will render *the clear sound*, while those regions

which correspond to the liver and spleen, will afford a sound, which is more or less *dull*, in proportion to their thickness and density; that the heart will give a *flat* or *dull sound*, though less evident, and accompanied with a less degree of resistance to the fingers, because the heart contains a fluid within it; and that lastly, the stomach, (an organ filled with gas,) will render the *clear sound;* so marked is this character, that when it contains gas mixed with liquids, the term tympanitic or humorique, has been applied to it; the presence of aliment, will of course render the sound more or less *flat* or *dull*.

The topography of the organs, in the normal state, including their situation, position, the space which they occupy, and their dimensions, constitute the second general problem in percussion; it is entirely anatomical in its character, whence we derive its most important peculiarities.

Though the reader may already be in possession of all the elements of diagnosis, as far at least, as regards the normal and abnormal states of organs by percussion, he should, nevertheless, remember that the study and difficulties of its application do not terminate, where purely theoretical principles end. We cannot too often repeat, that it is only by an exact knowledge of the position and degrees of sonorousness of the

organs in the healthy state, that certain and unvarying indications can be drawn from percussion, and that this information cannot be obtained, except by direct and repeated experiments upon the thorax of persons in health.

### *Percussion of the anterior part of the Thorax.*

In the percussion of the anterior part of the chest, the patient may occupy either the sitting or recumbent posture, the arms should be placed along the trunk, and the head flexed, so as to prevent the contraction of the pectoral and sterno-cleido mastoid muscles, which might give rise to a false obscurity, or dulness of sound, particularly in the supra-clavicular region; if the patient adopt the recumbent position, he should be drawn close to the edge of the bed, next which, the examiner stands.

It is usual to commence with the exploration of that part of the right lung, which rises above the clavicle; in this examination, the head should be slightly turned to the opposite side. The marked depression of this part, will present many difficulties to the employment of the plexímeter; it will therefore, be much better to use in general the index finger for this purpose, which

should be placed parallel with the long axis of the clavicle.*

The *clear* or *pulmonal* sound pervades the whole of this region. In exploring the sub-clavicular region, recourse must be had to the plexímeter, except in the case of thin subjects, in whom the finger will be found to be more convenient, as its size does not exceed that of the intercostal spaces: the sound peculiar to this region, is still the *clear* or *pulmonal*, though it is slightly obscure at the mammary region; it will, therefore, be advisable, in the case of persons who are corpulent, or with females, to make use of a greater degree of force.

It will be observed, that the *clear sound* is elicited from the whole of that portion of the chest, which is situated between the summit of the lung, and the sixth and seventh ribs; reference being here made solely to the normal condition.

At the sixth rib, or somewhat lower, we begin to perceive a diminution of sound, the *dulness* of which, at first indistinct, in consequence of

* In order to obtain positive signs, by means of percussion, the patient should be made to sit up, whenever it is practicable. In examinations of the anterior part of the chest, the arms should be carried backwards: if the lateral portions are to be explored, they should be raised above the head, and should be crossed in front of the chest, when it is intended to percuss the dorsal region of the thorax. By adopting these positions, the muscles covering the different regions to be examined, are rendered tense, and consequently, do not modify the sounds elicited from the subjacent organs.—(*Transl.*)

a prolongation of the lung, interposed between the liver and the walls of the chest, now becomes marked in its character, especially if percussion be executed with force.

Lower down, the *flat* or *dull* sound is made manifest, upon the slightest shock; it is continued as far down as the border of the false ribs, beyond which, the *clear sound* of the intestines commences. The distance between the points, whence the *flatness* begins, to that at which it ends, indicates the extent of the liver, and bounds the right hypochondrium. By repeating percussion vertically, at different distances, in parallel lines, and by carefully noticing each point of transition, above and below, an exact idea of the superior and inferior limits of the liver may be obtained.

The superior boundary corresponds to the insertion of the diaphragm into the walls of the chest, while the inferior coincides with the cartilaginous edge of the false ribs, except internally at the projecting angle of this border, where the liver extends a little beyond it.

After the right side of the thorax has been percussed vertically, the exploration should next be made in a transverse direction. The sub-clavicular region, situated between the clavicle and the sixth or seventh rib, will be found to yield anew, the *clear sound* of the lungs, though its

lateral limits cannot be defined, since it is prolonged outwards, beneath the axilla, and internally, to the anterior mediastinum : a portion of this region, however, comprised between the fourth and sixth ribs, affords, towards the sternum, the *flat* or *dull* sound.

The transverse percussion of the inferior portion of the thorax, which is included between the sixth, and the edge of the false ribs, (right hypochondrium,) will render throughout, the *flat* or *dull sound* of the liver, though it will vary according to the degree of elevation at which percussion is practised. Externally, the obscurity of sound is prolonged quite to the posterior surface, in consequence of the elongation of the liver behind. Towards the superior part, the internal limit of the *flat* sound, of the liver, is about an inch from the median line, where the *pulmonal sound* succeeds, until it again meets that of the heart. Towards the inferior portion, it extends a little beyond the internal cartilaginous edge of the false ribs. By uniting these extreme points, we have at once the internal boundary of the secreting organ of the bile.

In those rare cases, in which the heart is separated from the liver, by the diaphragm only, it will be difficult for any but an experienced observer, to recognise the transitions of sound ;

inferiorly, however, the tympanitic character of the stomach, will remove all uncertainty in fixing the lateral borders of the organ.

In percussing the right side of the thorax, in the transverse direction, it is requisite to take the same precautions, as when exploring it vertically, especially on arriving at the superior edge of the liver: the shock should be given at this point with greater force, in order to distinguish the sound of the organ, from that of the thin elongation of the lung which covers it. Below this point, the slightest stroke will produce the *flat* or *dull sound*, with resistance to the finger; this is not the case at the lower internal portion of the liver, which is here continued by a thin expansion over the intestines, and the pyloric portion of the stomach: if percussion be executed with force at this point, vibrations will be communicated to the subjacent organs, in which the tympanitic will disguise the *flat* or *dull* sound of the liver, which covers them.

Before passing to the examination of the left side, we shall devote a short time to the consideration of the sternal portion. By applying the pleximeter to the superior piece of the sternum, and percussing from above downwards, the *pulmonal sound* is obtained in the normal state, for the space of an inch and a half. At two inches above the point where the ziphoid cartilage is

united to the sternum, the presence of the right auricle of the heart, will render the sound somewhat *flat* though unattended with any sensation of resistance; at a short distance below this, the *dull sound* gives place to the tympanitic character of the stomach. After having carefully marked the two points of transition with Nitras Argenti, the exploration of the left half of the chest, will be next in order. The method of proceding, is precisely the same as already explained: the percussion of the supra and subclavicular regions, from the summit of the lung, to the fourth rib, will give exactly the same results as the corresponding portions of the opposite side. The similarity of sonorousness, should engage the practitioner frequently to repeat and compare the examination of the right and left sides, so that the sound derived from each lung, may be of reciprocal advantage, in the formation of a correct opinion.*

When percussing transversely, from the right towards the left side of the thorax, we might be surprised, that the sound afforded by the sternal portion which is interposed between the two late-

* In examinations of the chest, the practitioner will derive greater advantage from percussing alternately, corresponding regions of the opposite sides, than by completing the exploration of one half of the thorax, before proceeding to the other, since it is impossible to detect minute differences of sound, unless the shocks executed upon opposite regions, succeed each other immediately.—(*Transl.*)

ral divisions of the chest, does not materially differ from that yielded by the parieties covering the lungs. We should however recollect, that the sternum, which covers the mediastinum, does not correspond superiorly with any organ, which can render the *dull* or *flat sound ;* besides which, its bony composition, acting as a large pleximeter applied over the lungs and mediastinum, will necessarily communicate its vibrations to the former.

Below the fourth rib, the sonorousness of the two sides is no longer the same, in consequence of different organs occupying the two sides: instead of the liver, we have now the stomach. The space comprised between the fourth and sixth ribs, answers accurately to the lungs, on either side; but there is no organ on the right, as the heart on the left, which can yield the *dull* or *flat sound*.

By holding the pleximeter at about an inch from the median line of the sternum, and moving it from above downwards, parallel to this line, *dulness* or *obscurity* of *sound*, (cardial,) is perceived near the fourth rib which is more marked than that of the left ventricle, and is continued as far as the sixth rib. Thus, by uniting the two points already marked upon the sternum, with the two just indicated, the superior and inferior boundaries of the heart will

be obtained; the line which marks the superior limit of this organ, if prolonged, would pass through the nipple, or a little below; the inferior would intersect the depression, which exists at the union of the ziphoid cartilage with the sternum. Beyond, at the left hypochondrium, the *dulness* gives place to the tympanitic sound of the stomach, which extends to the edge of the false ribs, where it is replaced by a less degree of the tympanitic. External to the heart, the *pulmonal sound* descends as far as the sixth and seventh ribs, when the tympanitic character of the body, and cul-de-sac of the stomach succeeds, and is continued quite to the cartilaginious border of the false ribs. External to this again, will be encountered the *flat sounds* of the spleen, and of the stomach, in case it be greatly developed. The transverse exploration, affording always the same results as the vertical, is useful only, in determining the transverse diameter of organs, and may be advantageously employed, when we wish to be made acquainted with those of the heart, stomach, and spleen, in case the latter be developed at the anterior face of the thorax. We shall examine the spleen, when speaking of the posterior portion of the thorax, where, in the normal condition, it is situated. The stomach is so moveable, and its di-

mensions so variable, that it is impossible to assign to it any precise limits.

At present, we shall confine ourselves to the transverse diameter, including the external and internal limits of the heart. In this examination, let the pleximeter be moved transversely across the sub-clavicular region, approaching gradually, the superior portion of the heart. On meeting with the limit of this line, already noted, the presence of which, will be manifested by the succession of the *dull* to the *clear sound*, the transverse percussion should be pursued with great care; it should be commenced at two or three inches to the right of the sternum, and should be continued successively to the left.

Along the first transverse lines, still superior to the border of the liver, may be observed ordinarily, at the right, the *clear sound* of the lungs; along the right border, or rather the median line of the sternum, may be heard a slightly *flat* or *dull sound*, owing to the presence of the right auricle; it is not, however, accompanied with any sensation of resistance. Sometimes, the obscurity will manifest itself at the distance of an inch or more to the right, though rarely at half an inch to the left of the sternum. This character is prolonged more distinctly, from the point of its internal origin towards the left, where it soon gives place to the *pulmo-*

*nal sound* of the lungs. Along the transverse lines, corresponding to the inferior part of the heart, will be observed, to the right, the *flat* or *dull* sound of the liver, to which succeeds either mediately or immediately, that of the right portion of the heart: the *flatness* varies, however, according to the precise situation occupied by the heart; this may be at times, more in the direction of the median line, or again, it may be to the right or left of it. It may also happen, that the liver extends towards the left side. If the slightly *flat sound* of the right ventricle, succeed only *mediately* to that of the liver, the portion of the lung or mediastinum, which separates them, will render the *pulmonal sound;* if on the contrary, the *dulness* of the heart succeed immediately to that of the liver, it will be exceedingly difficult to distinguish the transition from one to the other, since they are separated only by the diaphragm. It is sufficient however, to know the superior points of its internal boundary; for when these are once established, it is easy to determine the remaining ones, by making a vertical line pass through those which have been fixed by percussion, as has been already done, when fixing the internal boundary of the liver.

Proceeding in this way, the external side of the heart, alone remains to be ascertained. This

investigation, will present no difficulty, since to the *slightly obscure sound* of the right ventricle, succeeds the marked *dulness* of the left: after this, we have the *pulmonal sound*, which continues throughout. The extent of the surface, over which this *flatness* extends, will be from an inch and a half to two square inches. It will, however be seen, that this area does not correspond to the volume of the organ: this apparent difference, is easily accounted for, when we reflect that in this region, the left lung covers about one half of the left ventricle. This part of the præcordial region, will afford on percussion, the *clear sound;* and it is the transition from the *dulness* of the internal portion of the ventricle, to the *clearness* of the pulmonary tissue, which covers it at this point, that we have taken as the lateral limit of the circulatory centre. On percussing however more externally, a sensible change is perceived, between the sound obtained from the last named point, and that derived from the walls of the thorax, which no longer correspond to the heart. This latter examination is however, no longer practised; since the extent of the heart's surface, which answers immediately to the walls of the chest, is always in proportion to its volume, which it cannot increase, except by crowding the lungs in an outward direction.

*Percussion of the posterior portion of the Thorax.*

The percussion of this part of the chest, offers no less interest than the anterior. It is, in fact, the most considerable portion of the lungs; corresponds to the great vertebral cavities, and is, in consequence of its dimensions, exposed more frequently to morbid conditions. The vertebral column, when percussed along that part of it which answers to the thorax, will render the *clear* or *pulmonal sound*, resulting from its immediate relation with the lungs, as far as the second and third false ribs.

After the exploration of this median ridge, the percussion of the parts situated at the right and left, will follow: these form by their union, a central portion, stretching from the summit of the thorax to its base, between two vertical lines, which pass by the vertebral borders of the scapulæ.

The *clear* or *pulmonal sound*, will be observed throughout the whole extent of these boundaries, as far as the second and third false ribs, which here correspond to a thin prolongation of the lungs within. Although this region is situated immediately external to the lungs, throughout the whole extent of the thorax, still their relative thickness at different points, and sometimes the situation of subjacent organs, abnor-

mally developed, as the heart, stomach, or liver, will exert a direct influence over the sound obtained. It is however easy to discover the nature, as well as the position occupied by these alterations of structure, nor is it difficult to ascertain which particular organ is the seat of the disease.

The two divisions which remain to be examined, have almost the same transverse diameter as the central portion; they are bounded externally, by a vertical line, which would pass by the posterior edge of the axilla; inferiorly, by the external portions of the base of the thorax; and superiorly, by the supra-spinous regions, answering to the posterior summit of the lungs.

The supra-spinous regions, corresponding to the supra-spinous fossæ of the scapulæ, will give no definite sound, unless the depression of the shoulder allow of percussion at the ribs; otherwise, the thickness of the scapula will absorb the vibrations. In the natural or normal condition of the lungs, the *clear* or *pulmonal sound*, will be obtained throughout the whole extent of the posterior portion of the thorax, though its character is less marked, than that derived from the anterior, in consequence of the greater thickness in the muscles covering this part; a slight acquaintance however, with the difference of sound, which characterizes the percussion of

this portion of the chest, will suffice to prevent the occurrence of any erroneous conclusions; indeed, the elasticity which is experienced under the fingers when percussing, will remove every suspicion of the existence of a morbid condition, though its presence might be inferred, in case the sound should be distinct.

In order to percuss the sub-spinous region, the shoulder must be separated from the trunk, by directing the superior extremities upwards and outwards, or by withdrawing them from the sides, by fixing them downwards and inwards. In the former case, the pleximeter should be applied immediately to the ribs; in the latter, the shoulder will be so exactly fixed against them, that it will transmit the vibrations without any difficulty. This region, bounded inferiorly by the sixth or seventh rib, which corresponds to the inferior angle of the scapula, affords the *clear or pulmonal sound*, somewhat more distinctly than the supra-spinous region. Lower down, the sonorousness of the two sounds is no longer analogous; at the right, we have the *flat* or *dull sound* of the liver, which continues throughout the whole region, except at its internal boundary, where the *clear sound* loses itself insensibly, in the obscurity of the liver, occasioned by a thin prolongation of the lung.

Percussion should be executed with consider-

able force, both above and on the inner side, in order to distinguish the *flatness* of the liver, from the *clear sound* of the thin portion of the right lung, which covers its superior and internal boundaries. A very marked *pulmonal sound* will be noticed at the left, which, whatever may be said by Avenbrugger to the contrary, continues much lower than on the opposite side; in fact, it does not cease until the presence of the spleen renders the *flat* or *dull sound*, which is however, less distinct in its character, than that of the liver; it extends over a surface of three or four inches.

In many cases, the spleen, besides being very small, is encroached upon by the intestines and stomach, especially when they are dilated; it will in consequence, be found that the *tympanitic sound* will often proceed from the region which should be occupied by the spleen. The points of transition, from the *pulmonal sound* to the *dulness* of the spleen, and of this latter to the *tympanitic sound* of the stomach, will give us an exact idea of the situation of the former organ. Again, should it be separated from the kidney, by an intestinal fold, the rapid transition from the *dull sound* of the spleen, to the tympanitic character of the intestine, will at once acquaint us with its inferior border; when however, this organ is in direct contact with the kid-

ney, it is by strong presumptive evidence only, that we can judge of the exact termination of the former.

*Percussion of the lateral portions of the Thorax.*

The right and left axillary regions, bounded before and posteriorly by the lateral limits of the anterior and posterior surfaces of the chest; above by the axilla, and below by the sixth and seventh ribs, afford on percussion, the *clear* or *pulmonal sound*.

The inferior portions, which terminate at the base of the thorax, give a sound analogous to that of the anterior surface, to which they correspond.

In the right inferior region, will be noticed the transition of the *clear* or *pulmonal sound* of the lungs, to the *flat* or *jecoral* character of the liver, which latter continues until, passing beyond the thorax, the *tympanatic sound* of the intestines intervenes.

At the left, percussion affords superiorly, the *pulmonal sound*, which, however, is *stomical*, when this organ is distended; below, we have the sound of the stomach, and sometimes that of the spleen; beyond the thorax, the tympanitic character of the intestines is present, as be-

fore mentioned, when speaking of the opposite side.

The above are the results which may be verified by the percussion of the thorax. It is however, necessary that it be executed with the greatest uniformity, and that the force of the impulsion be proportioned to the thickness of its walls. The rules which we have prescribed, for the proper application of percussion, are it is true, not those which are easiest learned; but it will be found that they may be soon acquired by practice.

We have already remarked, that the results obtained from different persons, in a state of health, are not always identical: this arises from the difference of the organs, contained within the cavities of the body, which without being abnormal, may at times be slightly irregular. This latter circumstance, should teach persons who are just beginning the study of percussion, to examine subjects of various conformation, in order to become acquainted with the seat of each sound and its natural limits.

As to distinctions derived from the different sonorousness of the organs, when the varietes are marked, they are perceived less by a comparison of the sounds with the fundamental type, the character of which is originally fixed in the memory, than by the change which strikes the

ear as we pass when exploring, from one organ to another.*

### *Abnormal Condition.*

The *clear sound* of the lungs, depends upon the presence of air in the pulmonary vesicles ; whenever there exists any obstacle to its introduction, or whenever it accumulates in greater quantity than the function of respiration requires, there will result a morbid state, which will be easily recognised on percussion.

Many causes may occur to prevent the introduction of air into the vescicles, such as—

First—The effusion of fluid between the two pleuræ, compressing the parietes of the vesicles, so as to destroy their cavities.

Second—The existence of pneumonia in the second or third stages, (red or gray hepatization of the lungs,) in which the cavities of the vesicles are obliterated, as much by the tumefaction of their parietes, as by the concretion of the sero-sanguineous or purulent matter which they contain.

* The sonorousness of the chest, is frequently modified by circumstances affecting other regions of the body, although the organs contained within the thorax, remain in a normal condition, as the presence of tumours in the abdominal cavity—utero-gestation, ascites, aneurism of the aorta, innominata, or subclavian arteries : all of which, by encroaching upon this cavity, diminish its extent, and consequently, render the sonorous vibrations less distinct.—(*Transl.*)

Third—The presence of interlobular and intervesicular tubercles: the former encroach upon the external walls of the vesicles, between which, in the interlobular tissue, they are situated: the latter prevent the entrance of air, by filling up the vesicular cavities.

Fourth—The dilatation of the bronchi, which crowd and compress the parietes of the vesicles.

Fifth—The existence of various tumours in the thoracic cavity, which by their density, prevent the transmission of parietal vibrations to the lungs, and which may also present an obstacle to the entrance of air into the vesicles; compressing them in the same manner as interlobular tubercles. Again, the effect of the obstacle may be confined to the diminution of the quantity of air, without excluding it entirely; this may be caused by secretions from the lining membrane of the bronchi, as in catarrh, or from the walls of the vesicles, in the case of pneumonia in the first stage; the same result will take place, when there is simple engorgement without complete obstruction. In all these morbid conditions, the parts corresponding to the seat of the lesions, that have been enumerated, will present an abnormal sound, which Avenbrugger has compared to that, which results from the percussion of *flesh* or *muscle*. "Si per-

cussus thorax in loco alias sonoro, carnis percussæ sonum ediderit."

The *dulness* and *resistance* are in direct proportion to the thickness of the portion of the lung, which the air cannot permeate, and the density of the foreign body, which occupies the place of the air. In the case of pneumonia, during *the first stage*, the fixed *dull* or *flat* sound, will not be well marked: indeed, a feeble *resistance* only, will be felt by the fingers; whilst in pneumonia, in *the second* and *third stages*, the most decided character of *flatness*, will be united to a resistance so marked, that, as has been said by M. Piorry, a painful sensation is experienced when striking the pleximeter, if accurately applied over the hepatized portion of lung. If the existence of tubercles, prevent the introduction of air into the vesicles, the percussion of the parietes which correspond to their seat, will give a sound more or less *dull*, according to their developement. The sensation of *resistance* to the fingers, will be considerable, in proportion to the tubercular masses, and will, in some instances, be accompanied by a feeling of hardness, analogous to that of bone. In reference to the various tumours, which occasionally form within the cavity of the chest, they will always render the *flat sound*, accompanied with a *resistance* to the fingers, which is more or less

marked, according to their nature. Corvisart has observed, that the costal pleura becomes considerably thickened, about the fourth day of the duration of inflammation, which gives rise to the *dulness of sound*. We have at present, under our observation, a patient, in whom we have verified this *flatness of sound* on the third day after the invasion of the pleuritic attack; it is of considerable extent, involving most of the left lateral portion of the chest, and is accompanied with incontestible evidences of false membrane; but without a single trace of pleuritic effusion.

In the cases which we have just cited, the abnormal state depended upon a diminution or deficiency of air in the passages, and was distinguished, both by the *dulness of sound*, and a greater or less degree of resistance to the fingers. In the cases which follow, the morbid condition, resulting from too great a quantity of this fluid in the air tubes, will be manifested by a preternatural *clear sound*.

This latter phenomenon is observed—Firstly, In dilatation of the vesicles by air, (vesicular emphysema.)

Secondly—In certain cases of dilatation of the bronchi.

Thirdly—In pneumo-thorax, and hydro-pneumothorax, where there exists a small quantity of

fluid and much gas. In the two latter instances, the *tympanitic sound*, is owing to the gas contained in the pleural cavity, sometimes occurring from a gaseous exhalation from the pleura, and at other times, in consequence of the rupture of a cavern into this cavity. Finally, if a large cavern, still entire, be filled with a considerable quantity of air, a resounding noise will be heard on percussion. In this case, the cavern having no opening on the side next the pleura, forces the air to escape through the bronchial tubes, at each depression of the thorax, and modifies the character of sound in such manner, as to resemble perfectly that of *a broken* or *cracked vessel*.

An exact idea of this sound may be obtained, by approximating the palms of the hands, as frequently practised by children, in such manner, as to form a cavity imperfectly closed, and then striking the hands thus arranged against the knee; the compressed air escaping through a slight fissure, analogous to the calibre of the bronchi, will give rise to the same character of sound.

We are not to attribute this to the presence of a fluid, though many authors have done so, and have described it under the *humorique* or *hydro-pneumatic sound*.

The great resemblance which it bears to

the noise of metal when struck, has caused some writers to designate it under the name of the *metallic tinkling;* but since all these expressions tend to give a false and equivocal idea, we have adopted exclusively that of *bruit de pot félé*, or sound of a cracked pot.

In order to hear this sound distinctly, it is necessary that the patient open the mouth, so as to allow free egress to the air; if the mouth and nostrils be entirely closed, this phenomenon will instantly cease.

In concluding our remarks on the formation of correct diagnosis, in diseases of the lungs, we should add, that the examination of these double organs should always be made on both sides, so as accurately to compare together, the results thus obtained. The sonorousness of the same lung, during inspiration, the retension of the air, and its expiration, should in like manner be submitted to the test of attentive comparison: thus, if the *dull sound* be noticed in a region which corresponds to the lung, before arriving at any conclusion, in reference to its condition, it is necessary, according to the advice given by Avenbrugger, to make the patient inspire, to retain the air for some time, and then to allow him to empty the chest, and during each of these stages, to percuss the different parts of the thorax. If the lung be indurated, the air cannot en-

ter in any considerable quantity into the vesicles during inspiration, and the sound before and after the expulsion of the air from the chest, will be analogous; a character which is never met with, if the lungs be not in a healthy condition.

We have already remarked, that in the normal state, the stomach renders the *tympanitic sound*, at the inferior portion of the left half of the thorax, comprised between the *seventh* and *eighth ribs;* it is however, possible that this viscus, distended by a considerable quantity of gas, may encroach upon the diaphragm and the adjacent parts, in such a manner, as to afford this sound as high as the fifth rib.

The various affections of the heart, have also a marked influence over the degree of its *flatness* and *resistance*, as well as over the extent in which these two varieties of sound present themselves; thus, sanguineous congestion of the heart; the presence of considerable masses of grumous blood in its cavities; hypertrophy especially, when accompanied with dilatation; effusion in the pericardium, &c., will all give rise to considerable *dulness* and *resistance;* again, the heart may encroach upon the lungs, by the augmentation of its volume, which would give rise to all the above physical signs. The liver and spleen, by abnormal developements, may also produce

the *dull sound*, beyond the limits they occupy in the healthy state. It sometimes happens, in consequence of hypertrophy, or congestion of the liver, that its superior edge is elevated above its ordinary boundary; sometimes the left lobe is elongated, and reaches quite to the cul-de-sac of the stomach, and at other times even to the spleen; of course, the *dull sound* will suffer an equal extension, with the organ from which it proceeds.

If the substance of the liver be filled with scirrhous masses, a decided sensation of *resistance* will be experienced by the fingers. The presence of hydatids will afford, on percussion, a particular vibration, analogous to that produced by a repeating watch, when placed in the palm of the left hand, and the glass struck by the fingers of the other; the vibrations of the watch, are owing to the oscillations of the bell in its machinery; in the other case, it depends upon the oscillations of the hydatids. M. Briançon, in a dissertation, sustained before the Faculty of Medicine, at Paris, maintains that the vibration is in direct proportion to the quantity of the acephalocysts, and inversely to that of the fluid; the presence of which is, however necessary to its production.

The spleen, though less subject than the liver to morbid affections, is nevertheless, not exempt

from them. One of its principal lesions is hyperthrophy, the limits of which may be determined by the extent of the *dull sound*, which corresponds to the spleen.*

## CHAPTER III.

### PERCUSSION OF THE ABDOMEN.

### *Normal Condition.*

Under this head is included all the organs situated between the base of the bony thorax, and the superior circumference of the pelvis.

The anterior wall of the abdomen, of greater extent than the posterior, is extremely elongated in the median line, where it corresponds above to the hollow at the base of the thorax, and below to the summit of the obtuse angle, which the folds of the groins make by uniting at the pubis.

During the examination of the abdominal organs, the patient should recline upon his back, while at the same time, the muscles of the ab-

* The frequency of enlargement of the spleen, should point out to practitioners, the necessity of always percussing this organ, in order to determine whether there be any augmentation of its volume. The supposed connection between this increased size of the spleen and intermittent, and continued fevers, has not been verified by M. Louis, who, after repeated examinations, found it but twice enlarged after the former, and but once after the latter.—(*Transl.*)

domen should be relaxed. This latter indication will be best answered by causing the legs to be flexed upon the thighs, and these latter, to be again bent upon the pelvis.

The ivory pleximeter is generally employed in the percussion of these organs ; inasmuch as the finger is neither sufficiently large, nor can it be firmly fixed upon the moveable parietes of the abdomen.

When percussing transversely the anterior part of the base of the thorax, we have found to the right, the *dull sound* of the liver, to the left the *tympanitic sound* of the stomach. If we percuss the abdomen in the same direction, commencing at the limits of the bony thorax, we shall find in the hollow of the epigastrium, the *tympanitic sound* of the cardiac and pyloric regions of the stomach, though somewhat less *clear*, than that rendered by the external portion of this organ.

Lower down, the transverse colon extending from the right to the left immediately below the liver and stomach, gives the *intestinal sound* which is in like manner *tympanitic ;* it is however, rather less *clear* than that of the stomach. The whole of the remaining portion situated below this, comprising the supra-umbilical, the umbilical and infra-umbilical regions, render the *tympanitic sound* in a greater or less degree.

The percussion of the abdomen in a vertical direction will afford results no less marked. Let us commence with the right side. Starting from the first curvature of the colon, already stated as being external to, and beneath, the liver, and then descend along the ascending portion of this intestine as far as the cæcum. In all this course, the sound will be more or less *clear;* but the cæcum being almost exclusively filled with gas, will render a very distinct *tympanitic soumd*, (*stomacal*, if the expression be allowed,) a circumstance of which we shall take advantage hereafter. The percussion should next be cautiously continued inwards as far as the linea alba. This surface will afford the intestinal *tympanitic sound*, proceeding from the subjacent viscera; especially is this the case when the small intestines are filled with gas.

The median line of the abdomen, corresponding in the hollow, at the base of the thorax, to the pyloric region of the stomach, will also render the *tympanitic sound* throughout its whole extent to the os pubis. We shall in like manner discover the *tympanitic intestinal sound* in all the left half of the abdomen.

## *Abnormal Condition.*

The abnormal sound rendered by the abdominal parietes when in a morbid condition, differs from the normal, sometimes by its greater clearness, either in a single organ, as in the case of dilatation of the stomach, or from the whole abdomen, as in the case of tympanitis; at other times, on the contrary, by the opposite variety of *dulness of sound.*

This latter however, differs in its degree, and is accompanied by proportionate resistance. Difficult to circumscribe in the intestines, it is more definitely fixed and more accurately bounded when applied to determine hyperthrophy of the liver, or spleen, or to ascertain the presence of different tumours in the abdominal cavity.

In a healthy state, percussion affords no evidence of the presence of the bladder, the uterus, or the ovaria; so that, if dulness should be observed in a region corresponding to the seat of either of these organs, it is not to be considered as a morbid sign.

The percussion of the posterior part of the trunk corresponding to the abdomen, offers but little interest. It is exceedingly difficult to define accurately the kidneys, in their normal condition, through the thick layer of muscles of this region; and their morbid alterations not generally aug-

menting their volume, are consequently not detected by percussion.

It is an important precaution in exploring the abdomen, to apply the pleximeter sometimes superficially, and at other times to depress the parietes, so as to examine successively the superficial and deeply-seated organs. If a tumour exist in a lateral portion of the abdomen, an assistant should draw the intestines towards him, so as to avoid confounding the sound produced by the tumour with that of the intestines.

The examiner, when once thoroughly acquainted with this general exposition, will know exactly how to avoid the difficulties which are to be met with in its application, and can practice with great advantage the percussion of the thoracic and abdominal organs. The greater part of the signs obtained will be unequivocal. But I should reiterate, in conclusion, that this appreciation of the material qualities of organs cannot be too precise, nor the mensuration too exact.

# SECTION II.

# AUSCULTATION.

## CHAPTER I.

### OF AUSCULTATION IN GENERAL.

Auscultation has for its object the discovery, by means of the ear, of the functional sounds of the different organs. Its application is however, principally confined to the organs of respiration and circulation.

That Hippocrates applied the ear to the walls of the chest, in some affections, may be seen from the followin g passage :

"You will learn by this, that the thorax contains water and not pus, if, on applying the ear, during some time, to the ribs, you hear a noise similar to that of boiling vinegar."—(*De Morbis II.*)

Although in this passage the Father of Medicine has committed a fault, in stating that a sound analogous to that produced by boiling vinegar denotes the existence of purulent effusion in the chest, it is not the less true that he had been able to detect particular sounds in the thoracic cavity. In the present instance, it was without doubt the crepitant or sub-crepitant ronchus (*rale-crepitant*, or *sous crepitant*).

It is certainly a matter of astonishment that this celebrated observer did not push his researches further, and it is still more remarkable that none of his successors should have profited by this observation, to become acquainted with a series of phenomena, to the discovery of which he had opened the way.

Auscultation dates only as far back as 1816. Before this period, we were only acquainted with *inspection*, *succussion*, *mensuration*, and *immediate percussion*. It was not till Laennec had seen at the clinical visits of Corvisart, his fellow-student Bayle apply his ear to the region of the heart, to discover the condition of this organ, that he conceived the idea of auscultation, which method he applied to the lungs and centre of circulation.

The first instrument, which he made use of in prosecuting his researches, was a cylinder of pasteboard. At a later period, having made many experiments, he found that wood was the most advantageous substance, and had a cylinder turned, of sixteen lines in diameter, one foot in length, and pierced longitudinally by a canal of three lines in diameter, but widened at its extremities. This instrument having received the name of Stethoscope, (from στῆθος, '*chest*,' and σκοπέω, '*I examine*,') was formed of two equal pieces screwed together. The enlargement of

the inferior part of the canal was exactly filled by a cone of the same material, and was pierced by a canal of the same calibre as the central portion of the instrument. This part was called the obturator.

The stethoscope was employed, to convey to the ear, the sounds developed in the organs, whose condition was to be investigated. When the examination was directed to the lungs, Laennec advised the removal of the obturator; but if the heart were the organ affected, he was of opinion that it should be allowed to remain attached to the instrument.

The instrument has subsequently undergone many modifications, the most useful of which has been the reduction of its size.*

* The best stethoscope is that which most completely fulfils the conditions of a good acoustic tube, with the smallest volume. It should conduct to the ear the sounds produced at a distance, rather increased than diminished in intensity. It should present internally a conical or tubular conformation, and should be widened at the base.

The greater the dimensions of the extremity, or inferior orifice, in proportion to the superior, the more intense will be the sound transmitted to the ear, since the vibrations concentrated towards the superior orifice are the union of the sonorous vibrations impressed upon all the parts of the base.

The obturator, which Laennec advises should be added to the stethoscope, in the exploration of the heart, has for its immediate effect the equalization of the diameter of the tube, and for its mediate effect the diminution of the sound.

If then, the hollow of the extremity of the instrument be filled with the obturator, it is true that the degree of sound will not beincreased; but a great advantage will be gained, in being able to fix more defi-

At present, the stethoscope of M. Piorry, to which he has added the pleximeter, appears to us, on that account, to unite the greatest number of advantages. It however differs but little from that of M. Louis, these two instruments being each composed of a cylinder of seven or eight inches in length, are pierced longitudinally by a canal, widening more or less rapidly, and are terminated by an ivory disc, to which the ear is applied.

All these instruments preserve the obturator, first given to them by Laennec. The addition of this solid piece, the utility of which appeared so striking to the discoverer of auscultation in exploring the heart, is far from being evident to us. The stethoscope which we are in the habit

nitely the exact point of the heart from which the sound proceeds, since the small orifice of the cone can be only applied to an exceedingly limited surface.

Let it not be supposed that solids conduct sounds better than air; this is an error which has originated from mistaken observation. If a noise which is produced at the extremity of a beam is propagated farther, in a longitudinal direction, than the same degree of sound in the open air, it is because the atmosphere is not bounded laterally as is the case in the vibrations of the beam, and because the vibrations excited at any given point of the all-pervading agent, are propelled in all the cardinal directious at equal distances. This spherical extension diminishes the oscillations of sound, in a given direction, in proportion as the number and extent of the other sonorous rays are considerable. But if the air be bounded laterally, like the piece of timber, as is the case when confined within the walls of a tube, the feeblest sound produced at one extremity, will be extended to an astonishing distance.

of using is that of M. Piorry, the obturator of which we have replaced by a crayon of nitrate of silver.*

M. Montdezert has modified the ordinary stethoscope, so as to adapt it to the exploration of the posterior surface of the body of a patient, who is confined to his back. This alteration consists in attaching to it a flexible tube, made of gold-beater's skin, containiug a wire which is twisted in a spiral form.

From the very moment that auscultation appeared upon the theatre of medicine, the practitioners of the capital were converts to its truth and importance. Such however, has not been the fact in reference to the stethoscope. On reading the work of Laennec, we should be led to believe that he actually attached more importance to the instrument than to the great discovery which has rendered such incaculable benefits to the profession. Many physicians have endeavoured to supply the place of the stethoscope by the application of the ear directly to the part to be examined. These practitioners contest the utility of the instrument; indeed,

*This will be found of great service in determining, from day to day, any change which may take place in the organ affected, either in referenee to an increase or diminution in its volume. The effect aud value of the treatment pursued, may also be verified with great precision, great care being taken to mark, from time to time, upon the surface of the vertical and transverse diameters of tbe organ.—*Transl.*

both one and the other have even to the present day their respective partisans.

Since it is always better to have recourse to those instruments, which nature has given us, the unassisted ear may be employed whenever no causes adverse to the propagation of the sound are present.

If it be required to examine the respiration over a plane and extensive surface, as for instance, over the anterior and posterior portions of the chest, immediate auscultation would be preferable, because all the lateral part of the face which corresponds to the ear used in the examination, will propagate the sound by means of the superior maxillary and the cheek bone as well as those of the cranium.

But when it is necessary to auscult the supra-clavicular and infra-axillary regions, or to determine accurately the character of arterial sounds, as well as those of the circulatory centre which occupy a small surface, and are mingled with the respiratory murmur, it is requisite in all these cases to employ the stethoscope; added to this, the moisture and uncleanliness of the skin may in some instances be additional reasons for its use.

It is also possible, that cerebral congestion taking place more readily in a bent than an upright posture, may render the hearing so

obtuse as not to appreciate nice differences of sound; this opinion was entertained by Laennec, and offers another motive for substituting the instrument, especially in the case of plethoric persons.

Whether the stethoscope or the ear alone be selected, the examiner should place himself on the same side as the region which he proposes to explore, and should avoid all noises capable of distracting his attention. The examination may be conducted by placing the stethoscope or ear, either directly upon the skin, or upon a thin covering of linen.* The instrument should be accurately, and at the same time gently applied; it should be kept in position, by means of the index finger and thumb of the hand corresponding to the ear employed, which should be fixed exactly over the orifice of the stethoscope.

We will observe, that in general, percussion should precede auscultation. The former indicates, in the first place whether the organs are in a normal or morbid condition, whilst the latter analyses the abnormal state and determines its nature.

These investigations like those of percussion,

* Even a thin covering of silk should be objected to, as the rustling noise caused by this material renders the sound confused, any covering of flannel is also improper, as it absorbs the sound and thus makes it obscure.—(*Transl.*)

should be submitted to the test of rigid comparison; not only should the two sides be explored, but different points of the chest should undergo the same kind of examination. In case the existence of a morbid affection be proved at any given point of the anterior surface of the chest, it will be proper to examine the posterior portion at a point which is diametrically opposite to the former, in order to ascertain how far the disease extends in this direction.

The ability to recognize sounds appertaining to the healthy condition, must be first acquired, before proceeding to the consideration of those of the opposite state; this can be derived only from repeated experiments performed upon individuals of different constitutions.*

## CHAPTER II.

### STRUCTURE OF THE LUNGS.

BEFORE entering upon the consideration of the various phenomena, which the respiratory organs

* In general, it is preferable for the examiner, not to seize upon the first sounds noticed on applying the ear or stethoscope to the part, but to wait a few moments until the continued peculiarities of sound begin to impress themselves upon his hearing, as the nervous excitability of patients frequently causes irregularities in the movements of the heart and lungs which mask the true sounds observable in these organs.—(*Transl.*)

present, both in a state of health as well as disease, we have thought proper to premise some remarks on the internal structure of the lungs, and to embody the information which Reisseisen and other authors have added to this subject.

Malphighi in his time was of opinion that the parenchyma of the lungs was formed of the minute ramifications of the bronchi. "Unde fortasse tunica illa interna tracheæ in sinus et vesiculas terminata consimilem inchoatis vulgo spongiis vesicularum molem efficit." However Helvetius rejected this theory of his predecessor and maintained that the vesicles of Malphighi were nothing more than cellular tissue communicating by cells on every side and attached to the extremities of the bronchi. Thus he conceived, that during respiration, the air passed from one cellule to another, thence from one lobule to another, and so on through the whole lung.

Nearly similar to this was the opinion of Haller.

We shall now give the conclusive experiments by which Reisseisen has established and developed the original theory of Malphighi, being that which is generally received at the present day, and which M. Jules Cloquet has adopted in his excellent treatise on Anatomy.

*First Experiment.*—After having longitudinally

divided the trachea, bronchi and their divisions, he observed that the mucous membrane, beginning from the trachea, was continued quite down to the surface of the lungs, forming at first a simple cylindrical tube and afterwards dividing into small canals, which at each subsequent division became smaller and more numerous; these canals he found finally terminated in a cul-de-sac, and communicated with each other by their orifices at the commencement of their ramification; but without any communication with the remaining portion of the lung.

This termination in a cul-de-sac of the minute ramifications of the bronchi, constitutes the pulmonary vesicles, which being collected together in certain number, and placed in juxta-position, form lobules, each one of which is separated from that which is adjacent, by a thin lamina of cellular tissue through which pass the blood vessels and nerves.

*Second Experiment.*—Having separated one of the bronchi corresponding to one of the lobes, he inflated the whole lung by the trachea, and at the same instant passed a ligature around the bronchial tube which he had denuded. It was observed that the whole organ returned to its original state, except the lobule which received its air passages from the bronchus compressed by the ligature; this exception could not possi-

bly have existed if the lungs were formed of cells which communicated with each other.

*Third Experiment*.—In the first place he carefully detached a pulmonary lobule, and afterwards separated it from the surrounding cellular tissue. He allowed this lobule to become inflated, and then passed a ligature around its superior portion ; when left to itself it was found to remain distended with air.

He repeated the same experiment under water, and was not able to detect a single bubble of air, escaping from its surface.

Like results do not however follow similar experiments made upon the interlobular cellular tissue. Air, when injected into this latter structure, by a slight incision made upon the pulmonary pleura, spread in all directions and formed bubbles of different sizes, precisely analogous to those of emphysema, which disappeared very slowly after the inflation was stopped.

Shall we object with Haller to the two latter experiments, that each lobule is formed only of a collection of cells, but that the cellular tissue of each lobule is enveloped at its circumference by impermeable membranes, which prevent the passage of air from one lobule to another.

The dissections of Reisseisen demonstrate that these membranous envelopes are only imaginary, and that the pulmonary lobules are not sepa-

rated from each other, except by the surrounding cellular tissue ; it is besides even more satisfactorily proved by the experiments which follow, that the lobular tissue is only composed of the vascular ramifications of the bronchi, terminating in vesicles.

*Fourth Experiment.*—Having poured some mercury into the principal air tube of another lobule, insulated in the same manner as the preceding, he pushed the metal quite down to the surface of the lungs with the handle of a scalpel. Then by the aid of a simple lens, he was enabled to observe the columns of quicksilver traversing the air passages which at each division became shorter and more numerous, until they arrived at the pleura where the mercury accumulated in globules. If a lobule thus injected be compressed between two plates of glass, the metal being pressed with greater force into the terminating ramifications, will present still better their form, which will be noticed to resemble very closely the nodosities of a cauliflower, while the pulmonary vesicles are similar to its tubercles.

To put beyond all doubt the result of the preceding experiment, and to remove from his opponents the power of attributing the linear direction of the mercury to false passages formed by its specific gravity, Reisseisen varied the experiment in the following manner.

*Fifth Experiment.*—He plunged into cold water the lung of a calf recently killed. After several days immersion, it became collapsed by the disengagement of air, only a few bubbles of which remained in the vesicles: it was then thrown into hot water. The caloric having dilated the small portion of air retained in some of the vesicles, he was enabled to observe them, distended as they were, in the centre of a compact mass, formed by the approximation of the other compressed pulmonary vesicles.

On observing more closely the lobules thus inflated, and on pressing the air towards the pleura, he perceived the same structure as in the preceding experiment.

The opinion of M. Cruveilhier is however different from the above.

This anatomist maintains that each lobule is an agglomeration of cellules and vesicles, all of which communicate with each other, and correspond to a single division of the bronchi, as to a common pedicle. This difference of opinion, however, does not affect the explanation which we shall give of the phenomena of respiration.*

* The experiments of Professor Horner having definitely settled the fact of the lateral communication of the air cells of the lungs, I take great pleasure in subjoining his remarks upon this interesting subject:—(*Transl.*)

"Each lobe of the lungs is divided into a great many distinct lobules, which adhere together by intermediate cellular tissue. He

"After the bronchi enter the lungs, the cartilaginous rings lose their form and become only irregular laminæ, which constitute segments, forming by their reunion a complete circle, so that there no longer exists a membranous portion properly so called, and the bronchial divisions are completely cylindrical.

"The segments of the divisions of the bronchi are perfectly oblong, curvilinear, and terminate in angles, which are very much elongated, so as to permit them to glide upon each other, and be reciprocally received into the intervening space existing between them. They are however united together by fibrous tissue.

"This disposition in curvilinear and angular segments exists as far as the last bifurcation of the bronchi; but the volume of these segments continues to diminish, so that they soon

marks of three divisions are apparent on the surface by lines running in different directions, but they are made still more distinct by tearing them asunder. The lobules are subdivided into very fine air vesicles or cells, which may be considered as the terminations of the alternate branches of the bronchia. The opinion is generally held, that the cells do not communicate laterally with one another, as the cells of the bones, but only with the ramifications of the bronchia to which they respectively belong. Recent preparations, however, have induced me to abandon this idea, and to conclude that the cells of the lobules individually communicate, but not those of different lobules. I have succeeded in proving this by distending the air cells with tallow, and after the lung was dried by removing the tallow with spirits of turpentine. This process shows the cells of their natural size, and communicating freely."

form merely narrow lines and finally cartilaginous tubercles.

"The fibrous and membranous portions of the cylinder increase more and more over the cartilaginous, which ceases altogether, at the level of the last bifurcation of the bronchi by a tubercle which occupies the angle of this bifurcation. This last ramification is reduced to its membranous part."—(*Anat. Descriptive, Vol. II., page* 643.)

According to Reisseisen, at each point of division of the bronchi, these segments may be seen forming rings more or less complete, their use being to prevent the tube from being collapsed. The bronchi have the same two orders of muscular fibres which are noticed in the trachea, *viz.* the longitudinal and the circular. Reisseisen thinks that these fibres are prolonged as far as the extreme ramifications of the bronchi and the pulmonary vesicles. The experiments of Varnier seem to confirm his opinion. This experimenter has succeeded in exciting contractility in the terminating ramusculi of the bronchi, not merely by injecting liquids into them and inflating them with irritating gases, but still farther by irritating mechanically their external surface. M. Cruveilhier does not incline to the opinion that fibres exist in the vesicles.

Lastly, the lungs contain the ramifications of

the pulmonary artery and veins, of lymphatic vessels, and of nerves.

## CHAPTER III.

### AUSCULTATION OF RESPIRATION AND OF THE VOICE IN THE NORMAL CONDITION.

If any portion of the chest corresponding to the lungs be ausculted, at each movement of inspiration and expiration will be heard a prolonged murmur, answering to the gradual expansion and contraction of the pulmonary vesicles, and to the friction of the air against their parietes.

It is difficult to give an exact description of this murmur, or to compare it with any known sound; but a single examination will be sufficient to distinguish it and to impress it upon the memory.

We have already explained the mechanism by which it is formed, when pointing out the circumstances of its production. The friction of the air against the parietes of the bronchi and vesicles, appears to us, as it did to Laennec, the simple cause of its formation.

Very lately M. Beau has started a different opinion; according to him, the sound of natural respiration is produced "by the resonance in the whole column of air inspired and expired, of the

noise resulting from the compression of this column against the soft palate and adjoining parts." *

An opinion so paradoxical would require for its support conclusive experiments and close induction; those of M. Beau, even were they exact, are far from advancing the truth of his theory. Even though he may have heard the *souffle bronchique* less distinctly in the case, where the patient afflicted with an effusion in the cavity of the pleuræ, breathed without making any noise in the trachea, still this coincidence of the effect of the passage of air in the trachea and bronchi agrees very well with the general opinion.

In the case cited by the author of this theory, the respiration was only superficial, and the air entered in too small quantity into the bronchi for this sound to be heard with any degree of distinctness.

"When the guttural sound is suspended," says the author of this memoir, "the trachea and vesicular sounds no longer exist, and did you not feel under the ear, the thoracic parietes to rise and fall in measured succession, you might be led to the conclusion that the individual did not breathe at all."

* Archives Générales de Medicine, 11e serie, tome 5.

This then would be to make the guttural correspond with the tracheal and vesicular sounds. We will oppose to M. Beau, that if there were no other signs of respiration than those afforded by the elevation and depression of the chest, it is very probable it did not take place at all, or if it did exist without noise, it was because the air did not accumulate in sufficient quantity nor rapidly enough to produce it; and that the reasons for which the tracheal and vesicular sounds did not exist, are precisely those which prevented the formation of the guttural.

As to our own experience, it has furnished us with results directly opposite. Patients who surprised by the order given them to respire deeply, make more noise in the trachea, have in that case the respiration very slightly marked; on the other hand, we have distinctly heard the respiratory murmur, although feeble, in persons with whom the soft palate made no noise. But in order to meet with these cases, it is necessary to select persons in whom the expansion of the lungs is habitually very marked or whose respiration is puerile.

Although M. Beau pretends to have heard the natural respiration by blowing with a tube of paper against the soft palate of another person who held his breath, we have endeavoured after many and repeated trials to obtain the same

result. In most instances we have heard nothing in the chest; but sometimes an echo of the noise produced in the throat, which however had no analogy with the murmur of respiration. Besides, this fact would not substantiate the hypothesis of M. Beau any more than the rest.

If to these reasons be added the simplicity of the theory which we have adopted, and the incoherence of the latter, in which we are obliged to have recourse to various and complex mechanisms, in order to explain natural and morbid sounds, it will appear astonishing that such a paradox can find partisans.

We have however investigated this subject still farther, by some experiments upon animals. We have attentively ausculted with M. Auguste Pelletier the respiration of a healthy rabbit, and have found it very similar to the *blowing sound* which accompanies lesions of the valves of the heart in man. After having divided the trachea in a transverse direction, the sound still continued, when the animal soon expired. We next undertook a new series of experiments; by inspiring and expiring into the trachea through a small canula, taking care to make no noise with the mouth, we distinguished at each time a *blowing sound* analogous to that which we had heard during life, and yet the curtains of the palate in man differ from those of the rabbit, the respira-

tory murmur was more analogous to that of this animal in proportion as we imitated its short and hurried respiration.

It is then well demonstrated that the mechanism of the respiratory murmur is such as we have explained.

The respiratory sound is not the same in all individuals or in all parts of the chest. There are some persons, as remarked by Laennec, who have a naturally feeble respiration without any malady of the lungs, while there are others who have it ordinarily very loud and almost puerile.

In general, if the respiration be more feeble or more strong throughout the whole chest than in the normal state, it is more probable that it is not a sign of a morbid state of the lungs than if either of these forms occupies but a small extent.

However, the respiration is not heard with the same intensity in all parts of the chest; which results perhaps from the greater thickness of the lungs, or from the greater permeability of the vesicles in one region than in another.

M. Cruveilhier has assured himself by a great number of experiments that the lobules are unequally permeable, that an ordinary inspiration does not dilate more than a third of the pulmonary lobules; he observed, as M. Broussais had done before, that the most permeable lobules are those of the summit, whence it would follow that

these act habitually more than the other parts of the lung.

It is in the anterior and superior regions of the chest that the respiratory murmur is the most marked in the normal state. It is a little more obscure in the corresponding posterior part. In the interscapular space the respiration is naturally louder than any where else, because in this region are found the root of the lungs and the bronchi of large calibre.

The trachea renders a still more distinct sound, indicating the capacity of the tube in which it is produced.

Between the liver and the vertebral column the respiration is feeble, because in this part the lung is prolonged by a very thin lamina; in all the space occupied by the liver alone the respiration is wanting; it is the same in the region of the heart, except in those frequent cases where the left lung covers the circulatory centre.

In applying the ear to the inferior part of the thoracic cavity, behind and before, the rumbling of the intestines or the stomach is occasionally heard; it is necessary to avoid confounding these with abnormal respiratory noises.

In the normal state, the pulmonary approaches the costal pleura during each inspiration; but without producing any distinct respiratory sound.

If the patient under examination be made to speak, the voice resounds in the whole extent of the chest occupied by the lungs, and produces vibrations which the ear clearly perceives, but which appear to be arrested at the surface of the thoracic parietes without attaining to its side.

Towards the root of the lungs, under the axilla, and above all, over the trachea, the resonance is strongest, and the vibrations appear to be propagated to the ear, which sometimes experiences a disagreeable sensation, principally when ausculting thin persons with sharp voices.

The particular resonance of the voice in these different parts resembles bronchophony, of which we will speak hereafter.

When the hand is applied over the chest of a person who speaks, a soft but sensible vibration is felt in the normal state.

## CHAPTER IV.

### AUSCULTATION OF THE RESPIRATION AND OF THE VOICE IN THE MORBID CONDITION.

#### *Abnormal Respiration.*

To understand what we are going to say in this chapter, we should remember that three portions of each lung are to be considered: 1st, the bronchial part; 2d, the vesicular part; 3d,

the pleural part. When these three parts are exempt from lesions, the air passes freely from the bronchi into pulmonary vesicles producing the peculiar murmur which is proper to normal respiration. The lung being inflated by the air introduced at each inspiration, approaches the walls of the chest, the pulmonary pleura glides against that of the parietes, and yet no particular sound is produced by their contact.

But there are cases where each of the three pulmonary divisions (bronchi, vesicles, pleura) are healthy, and still the respiratory murmur or the vesicular respiration is more marked than in the normal state. This kind of respiration is normal in all infants, a circumstance that has caused it to be named puerile respiration. But its presence in adults indicates for the most part an affection of the lungs, not because the part where it is perceived is affected, but because the exaltation of the respiratory force, in one lung, indicates its weakness either in other parts of the same lung (partial pneumonia) or in the opposite one. Thus, when one lung becomes inactive in any affection, the other supplies its function by redoubling its energy.

What is the cause of this increase of the vesicular expansion? We do not think with some authors that the puerile respiration depends upon hypertrophy of the lungs, or in other words,

upon the augmentation of the number of vesicular partitions and vesicles. The rapidity with which this form of respiration is manifested in the different affections of the lungs removes every idea of hypertrophy properly so called, and leads us to admit the opinion of M. Cruveilhier.

This anatomist says that he has frequently observed lobules in the lungs, in reserve, and not acting except in deep inspirations.

Upon the strength of this observation, we think with this professor, that puerile respiration depends upon the entrance of the air into a larger number of vesicles, than in the normal condition.

Another augmentation of the respiration takes place in dilatation of the bronchi. The respiration is exceedingly loud; the ear easily detects the air passing through the tubes of a large calibre, before entering into the vesicles, of which a considerable part has become impenetrable to the air, in consequence of the compression caused by the parietes of the dilated bronchi. In this case the respiratory murmur is almost completely masked by the *diffuse bronchial blowing sound.*

In other instances, the dilatation being more circumscribed, forms a kind of cavern in the tube of the bronchus; and the destruction of the parenchyma of the lungs, resulting from the softening

of tubercles, may also form a cavern completely empty, which communicates superiorly by means of the bronchi with the rest of the lungs. In these two cases, the passage of air into the dilated portion will there offer, during each inspiration and expiration, a resonance proportionate to the extent of the cavern.

It is to this modification of the respiratory murmur, that the name *hollow inspiration*, or *hollow blowing sound*, has been given, which is more remarkable in proportion as the cavern is large and superficial.

When the capacity of the cavern is exceedingly great, and does not perpetually contain liquid, or only a little, a resonance may be heard at each respiration analogous to that produced by blowing into a decanter, keeping the mouth at a little distance from the neck. It is the same mechanism in both cases. A large cavern resembles sufficiently well a decanter, and its neck a bronchus; it is therefore not without reason that this kind of cavernous respiration has been called *amphorique*, (from *amphora*, *flask*.)

When a superficial cavern bursts into the cavity of the pleuræ, the air entering into that cavity during each inspiration produces this species of respiration more marked in proportion as the cavity of the pleuræ contains little or no liquid.

In other cases, the air penetrates the respiratory organs without producing any noise, and the two movements of respiration are silent.

After obstinate catarrhs, the parietes of the bronchi and pulmonary vesicles, immoderately distended by the continual efforts of coughing, lose their elasticity or their facility of contraction, the same as the abdominal parietes after long dropsies or repeated pregnancies. Such is the organic injury which accompanies the *extinction* of the respiratory murmur in the vesicular emphysema of Laennec.

In this affection, the vesicles and bronchi not contracting after their expansion, the act of inspiration is incomplete, the air inspired remains in these parts and keeps them dilated; so that fresh supplies of air, which arrive at each inspiration, are no longer capable of producing the murmur arising from the gradual expansion of the vesicles.

Laennec gave another explanation of this silence, which he attributed to the obliteration or impenetrability of the vesicles; but in that case we ought to hear the *bronchial blowing sound* arising from the passage of the air in the bronchi. The discoverer of Auscultation attributed the absence of the latter sound to the attenuation of the tissue composing the lungs, rendering them unfit to conduct the sounds

developed within them; but this explanation is only hypothetical.

We have said at the commencement of the chapter that the air passes from the trachea into the bronchi, thence into the vesicles, and that its passage in each of these parts is accompanied by a particular noise, of which the vesicular sound is more extensive than any other, and constitutes properly the respiratory murmur in a normal condition.

We have observed successively the augmentation of the respiratory murmur in the vesicles, when the vesicular lamina became more penetrable, and its increased resonance, on the contrary, in the dilated bronchi, and also in a cavern of the lungs, where the air arrived in greater quantity; we have next observed the vesicular murmur disappear, without the passage of the air being more distinctly heard in the bronchi, when the vesicles, without ceasing to be permeable, have lost their elasticity as well as the bronchi.

But if, from any cause whatever, the cavities of the vesicles were obliterated whilst the bronchi remained in a normal condition, the vesicular murmur would be replaced by that modification of the *bronchial blowing sound* which is called *bronchial* or *tubal respiration*.

This sound, which takes place in tubes of

normal calibre, cannot be confounded with the *diffuse bronchial blowing sound* which occurs when the bronchi are in a state of dilatation and only partially mask the respiratory murmur.

Thus, when a pleuritic effusion compresses the parietes of the vesicles and effaces their cavities, the respiration is found to be limited to the bronchi, and the *bronchial blowing sound* is now heard instead of the vesicular murmur.

The same phenomenon takes place in pneumonia in the second and third stages, where the pulmonary vesicles are no longer permeable.

This impenetrability does not result from concentric compression, but from the fact that the walls of the vesicles are tumefied, and thus have a tendency to obliterate their cavities, which besides are frequently obstructed by sero-sanguineous matter either purulent, viscid, or solidified.

It is also to be met with in what Laennec has denominated pulmonary apoplexy, which consists in the obstruction of the vesicles by the coagulation of extravasated blood.

When tubercles are formed in the pulmonary vesicles, the latter are nearly in the same condition as in pneumonia which has advanced to the second and third stages. The obstacle to the vesicular respiration in this case arises from the presence of tubercles in the vesicles; but if the

tubercles be formed in the interlobular tissue, they compress the vesicles from without and act in the same manner as effusions; in this instance the *bronchial blowing sound* will always be noticed.*

Before passing to the consideration of the other alterations in the respiratory murmur, we shall speak of the abnormal sounds produced by the approximation of the two pleuræ.

When vesicular emphysema, in which we have already verified the extinction of the respiratory murmur, takes a progressive march, it arrives at a point where it occasions the rupture of the vesicles, and the air in passing through the interlobular tissue, produces a particular *rale* ("*rattle*") with which we shall become better acquainted hereafter; it then arrives at the surface of the pleura, which it raises up by forming bubbles. In consequence of the friction occasioned by the approximation of the pleuræ, another sound is produced called by Laennec *bruit de frottement ascendant et descendant* (" noise

* The respiratory murmur is frequently increased in one part of the organ, while it is sensibly diminished and even extinct in another portion, in consequence of the congestive state of the latter. This is often noticed in the first two stages of pneumonia; in asthma; and in many other affections, where the calibres of the vesicles are encroached upon or obliterated by any pressure external to them, which throws an increase of function upon those parts of the lung which retain their normal condition.—(*Transl.*)

from friction, ascending and descending,") thus named because it occurs equally during the elevation and depression of the chest.

A sound analogous to this is heard whenever a false membrane exists between the two pleuræ, whether it adhere to one of them only, or extend from one to the other.

The intensity of this noise, formed by the same mechanism as the preceding, will vary according to the nature and density of the false membrane; if it be recent and soft, only a slightly marked noise from friction will be heard.

A large fibrous false membrane renders ordinarily a sound analogous to that of *rubbed parchment;* at other times it is more like that of *new leather;* in other cases again it is a *grating noise.*

Whenever the sounds of the pleuræ are intense, the hand, if applied over the parietes of the chest, will experience vibrations precisely similar to the *purring of a cat;* this circumstance is also met with in certain lesions of the valves of the heart.

In all the cases which we have just cited, the air penetrates more or less profoundly into the respiratory organs, without meeting with any obstacles in its passage; in the following cases, on the contrary, the difficulty which it experiences in finding its way into these organs, produces new sounds, which are comprehended

under the terms of *râles* or *ronchi*, ("rattling or snoring noises.")*

One of them, which we have alluded to in speaking of the *bruit de frottement ascendant et descendant*, has been known since Laennec's time by the name of *craquement* ("crackling,") or *rale crepitant sec à grosses bulles* ("dry crackling noise, with formation of *large* bubbles,") it takes place in pulmonary emphysema when the distension of the air passages, becoming greater and greater, is at last followed by rupture of the vesicles. The air then forcing itself a passage in the interlobular tissue, gives rise to this phenomenon during inspiration.

* In order that the respiratory murmur be distinctly heard, it is necessary that the air tubes should be lubricated by the secretion peculiar to them. If the moisture be in excess, the air becomes mingled with it, and produces bubbles which burst and crepitate; they constitute what are called *moist sounds* in auscultation. They are divided into large and small crepitations; the former occurring in the bronchi, the latter having its seat in the minute branches of the air tubes and pulmonary vesicles.

If, on the contrary, the fluid be deficient in quantity, the sounds produced have been called *dry sounds*, which have been divided into the sonorous ronchus and sibilant ronchus; the first is hoarse, the last a shrill sound. Sibilus denotes a deficiency of secretion in the smaller divisions of the bronchi, while the sonorous ronchus is pathognomonic of the same condition in the primary divisions of these tubes. Any obstruction to the passage of air however, will produce this ronchus at the root of the lungs, as the presence of tough mucus, aneurismal tumours, or ossifications. Sibilus is usually connected with crepitation, and its increase or diminution over the latter, marks the violence or alleviation of the disease, since there can be very little expectoration where it exists in a very marked degree.—(*Transl.*)

In the early stage of catarrh, when there is much congestion of the mucous membrane, it frequently happens that one of the bronchial tubes is contracted at some point of its course, and there forms a kind of glottis, which vibrates with every passage of air, and produces the peculiar sound *deep sonorous ronchus*, or *dry rattle of the bronchi*. This sound is distinct, in proportion as the engorgement of the membrane is considerable.

When there is stricture of a bronchus to a considerable extent, as exists in certain acute and also chronic catarrhs, when unaccompanied with expectoration, the air passing along the narrow passage of the contracted bronchus, produces a noise analogous to that of a current of air passing through a key hole. The ear perceives the difficulty which the fluid experiences in its passage by the whistling noise which it produces; this is called the *rale sibilant* (sibilus, "hissing.") This ronchus accompanies the two movements of respiration; but is more distinct during expiration. This difference is thus accounted for by Danse; he is of opinion that the movements of expiration not being so energetic as those of inspiration, the air experiences greater difficulty in the former case in traversing the contracted bronchus. This explanation, to say nothing more, appears singular.

The contraction of the calibre of a bronchus which occasions the phenomenon, may be produced either by the congestion of the mucous membrane, or, which is the most general case, by a lamina of viscid mucus lining the membrane, whence it happens that the *deep and sibilant sonorous ronchi* may exist and disappear within a very short space of time, according as auscultation is performed before or after expectoration.

We shall next examine the modifications of the respiratory murmur, which arise from the displacing of different liquids by the passage of air into the lungs.

In order to have a true conception of the varieties of sound, which the displacing of liquids secreted or exhaled by the mucous membrane may occasion, take tubes of different calibre and fill them with solutions of gum arabic of different consistence. On blowing into each of these by means of a common tube, various sounds will be observed, differing according to the dimensions of the pipe and the consistence of the solution.

The same laws, by the operation of which these latter are produced, occasion also the *ronchi*, or *rattles*, of which we shall now enter upon the consideration.

The displacing of the mucus in the trachea,

during the latter moments of life, gives rise to the *rale trachcal* ("rattle in the trachea.")

If a liquid of similar uniform consistence collect in a larger cavity as in a cavern, the displacing of it will give rise to a sound altogether different, known under the appellation of the *cavernous* or *bubbling ronchus* ("rale caverneux ou gargouillement.") If the cavern be large, this ronchus resembles very closely the gurgling sound produced in pouring water from a bottle; if on the contrary the cavern be small, it will not differ from the *mucous ronchus*.

The *mucous ronchus* is heard whenever liquids are collected in the passages of smaller calibre, as in the bronchi of the first order.

The ear applied over the parietes of the chest, distinguishes not merely the calibre of the tubes in which the sound is formed, but even the consistence of the secretions.

This *ronchus* or *rattle* frequently accompanies hæmoptysis and catarrhs, attended with mucous secretions. The ear detects the elevation and depression of these liquids by the passage of air, and also that the bubbles which they form with the latter, do not break until they have acquired considerable volume.

If to this ronchus be added those known under the names of *sibilant* and *deep sonorous ronchi*, the union of these two sounds will very closely

resemble the cooing of turtle doves and pigeons, or the cries of different birds.

If the liquids displaced be secreted by the bronchi of the second order, the air traversing these tubes of smaller calibre will produce a somewhat different sound called the *subcrepitant ronchus*. The crepitation which characterizes this noise, is produced by the rupture of bubbles of the size of large pearls.

If the morbid secretion take place in the vesicles, as is the case in the first stage of pneumonia, where the inflamed pulmonary vesicles exhale a sero-sanguineous and viscid matter, the air penetrating this substance during inspiration, forms bubbles within it ; the number of which is proportionate to that of the inflamed vesicles. When these bubbles burst, they are accompanied with a crepitation similar to that produced by the ebullition of any fat substance, or the crackling noise of salt when thrown upon burning coals ; this is the *crepitant ronchus*.

One of the characters which distinguishes this sound from the *mucous* and subcrepitant ronchi, with which it may sometimes be confounded, is that the bubbles of the crepitant ronchus are all equal, as are the cavities of the vesicles wherein they are formed ; while in the other ronchi the size of the bubbles may vary considerably.

Danse, to whom we are indebted for this

ingenious explanation of the production of the *crepitant ronchus*, affirms that this sound is only heard during inspiration. This fact arises, in our opinion, from the following circumstance; the viscous substance being confined in the cul-de-sac of the vesicles beyond which the air cannot pass during inspiration, no longer obstructs the passage of the air during expiration.

Another distinctive character established by Danse between the crepitant ronchus or rattle and the other humid ronchi, is that the former continues after expiration, whereas the latter disappear.*

The continuance of the crepitant ronchus after expectoration appears to me to depend upon this; that the substance expectorated in pneumonia does not come immediately from the pulmonary vesicles, but from the bronchi, which receive the surplus of what the vesicles are unable to contain.

There still remain two remarkable phenomena discovered by auscultation of the lungs.

* A majority of the ronchi are heard most distinctly during respiration; in order however to appreciate some of them, it is necessary to make the patient cough. Each variety may exist alone, or as is more generally the case, may be blended with several others. Some are permanent during the whole course of the disease, whilst others seem to intermit, appearing at different intervals during its course, as the various physical conditions for their formation exist in the lungs. (*Transl.*)

When a cavern bursts into the cavity of the pleura, a quantity of fluid will collect within it, proceeding from the cavern, or secreted afterwards by the inflamed pleura. In this case auscultation will discover a particular sound in the chest, called by Laennec *metallic tinkling*.

The author of auscultation attributed this peculiar noise, to the vibration of the air at the surface of the liquid, where it is agitated by the respiration, the voice, or coughing. Danse, in his work which we have already cited, advances the following opinion in regard to its formation.

When the level of the liquid contained in the cavity of the pleura, is superior to the orifice of the cavern, the air which enters at each inspiration into the lungs, rushes into the cavity of the pleura, rises through the liquid in the shape of a bubble by reason of its specific gravity being less, and arrives at the surface where it breaks and produces the noise known under the name of *metallic tinkling*.

This explanation received no attention until lately, when M. Beau without being acquainted with the observation of Danse, originated the same idea, which he explained and supported by numerous and repeated experiments.

According to M. Beau this sound can be equally heard during expiration, coughing, talking, and expectoration. In fact, he observes

although in all these cases the air be expired instead of inspired, still, since in the majority of cases of the existence of caverns, the surrounding part of the lungs is indurated and does not collapse during expiration, the air expelled from the rest of the lung rushes from the trachea into the open bronchi, and from thence acts as air inspired. This sound is most frequently observed to follow soon after each act of respiration ; but it sometimes occurs after considerable time has intervened, which appears to arise from the circumstance that the bubbles may remain some time at the surface of the liquid before bursting.

According to M. Beau, the same sound is occasionally heard in large caverns filled in great measure with liquid, and in hydropneumothorax, without the existence of any communication with the respiratory passages. But how is it possible to conceive in these two cases of the formation and rupture of bubbles ? Would it not be better to admit, in certain cases, of *metallic tinkling*, the simple explanation of Laennec, as for instance, when it accompanies the rupture of caverns into the cavity of the pleura.

It frequently happens with patients who are affected in the manner here indicated, that when they change a horizontal for a sitting posture, a few drops of liquid adhering to the pleura, or retained by false membranes, become separated

from the mass of fluid which is precipitated by the power of gravity to the inferior portion of the cavity. These drops, by falling on the surface of the liquid, produce a noise analogous to that made by allowing a drop of water to fall into a decanter, containing a quantity of fluid. This constitutes a variety of the sound already described as the *metallic tinkling*.

There exist other cases, in which this sound will present other varieties which differ altogether from the preceding.

Whenever the cavity of the pleura, or a large cavern in the lungs, contains liquids and gases, the shaking of the thorax will cause the fluctuation of the liquid to be heard; this is called by Hippocrates *succussion*, and has been known since his time under the name of *Hippocratic succussion*. This may be well imitated by shaking a decanter containing a small quantity of liquid.

### *Abnormal Resonance of the Voice through the Parietes of the Chest.*

We have before remarked that the resonance of the voice is very distinct in the regions where the bronchi are superficial; but less so in those regions which correspond to laminæ of vesicles, in consequence of the numerous divisions which the undulations of sound experience in

arriving at the extreme ramifications of the bronchi.

If however, the vesicular cavities become destroyed by any cause, the voice will resound in the bronchi corresponding to the obliterated vesicles, with a force proportionate to the extent of the lesion. This abnormal resonance of the voice through the parietes of the chest, takes the name of *bronchial voice*, or *bronchophony*.

The imperviousness of the cavities of the vesicles, whether it result from the presence of tubercles, or from the concretion of sero-sanguineous matter secreted by the parietes of the vesicles in the second stage of pneumonia, will therefore give rise to this phenomenon.*

Bronchophony may also be observed when the same condition of the vesicles exists from effusion into the cavity of the pleura. But if in this case, the liquid effused be in too small quantity to compress entirely the laminæ of vesicles, and only causes a closer application of the pleura to the parietes of the vesicles, so as to form a membrane more or less tense applied to the extremities of the respiratory passages, the

* Pneumonia, Phthisis Pulmonalis, and Dilatation of the Bronchi, are each characterized by the presence of this sound; in the last of which affections it sometimes partakes almost of the character of Pectriloquy, where the dilatation is very great; the history of the case, however, with other accompanying circumstances, will enable the examiner after careful auscultation, to detect the difference.

resonance of the voice will in this case offer a very remarkable character. It is a broken, interrupted sound, like the voice of a person who stutters. It has been compared to the bleating of a goat, whence its name of *egophony*.

Egophony may be imitated by speaking against the teeth of a large comb, one side of which should be covered with paper; it is by the same mechanism that this sound is formed in both these cases. The liquid contributes to the formation of egophony, by producing a like disposition in the chest. Thus, if the effusion be very considerable, egophony will be no longer heard, because the degree of compression is so great that the vesicular cavities are unable to transmit the sound.

According to some modern authors, egophony is an uncertain sign. We are far from pretending that it is always easy to appreciate this sound; but we think that with practice and attention, it may be easily distinguished from all other signs.*

When the air passages are dilated in a portion of the lung, more or less circumscribed, as hap-

* Egophony is met with, in Pleurisy, in Hydrothorax, and in cases of the recent formation of false membranes which are still soft. In Pleurisy, it is of considerable value as marking the existence and duration of the effusion. In those cases in which the requisite quantity of fluid exists to produce it, it may be easily detected at the posterior part of the thorax near the root of the lungs.—(*Transl.*)

pens in partial dilatation of a bronchial tube, or in an excavation consequent upon tubercles, the resonance of the voice in these different parts is so great, that the patient seems to speak in the ear of the examiner, especially if he auscult with the stethoscope. This is called *pectriloquy* ; it is complete when the cavern is superficial, and adheres by its parietes to the costal pleura, and when that portion of the lung which surrounds it is indurated.

If the bronchi be dilated to a considerable extent, the resonance of the voice will very nearly resemble *pectriloquy ;* but it will be more *diffuse*, and may be heard over several points of the chest.

On applying the hand over the parietes of the chest during *broncophony*, it will feel the *parietal vibrations* in the same degree as during the normal condition.

This phenomenon is no longer met with, when the lungs are separated from the thoracic parietes by a certain quantity of liquid.

# CHAPTER V.

## AUSCULTATION OF THE CIRCULATION OF THE BLOOD.

### ARTICLE I.

### *Auscultation of the Heart.*

The heart is also another organ, to which may be applied the laws of acoustics, to establish the diagnosis between a great variety of affections. But to have a good idea of the phenomena presented by it in the discharge of its function, we should first have a correct notion of its mechanism.

We shall therefore proceed, to enter upon such anatomical and physiological considerations as have reference to our subject.

It affords us great pleasure to acknowledge, that a large number of the facts mentioned in this chapter are due to Professor Bouillaud, to whose labours the science of medicine is indebted for an accurate knowledge of the circulating centre and its lesions.

Our observations have been selected either from the clinical lectures of this Professor, or from the new work which he has lately given to the public.

## *Anatomy of the Heart.*

The heart is a hollow muscle, having the form of an inverted cone. Its volume cannot be absolutely fixed. Laennec observed, that it is generally about equal in volume to the fist of the same person.

This organ is situated in the left cavity of the chest, where it occupies the region which corresponds to the inferior part of the sternum and the cartilages of the last true ribs of the left side. Its position is such that its base points upwards, backwards, and to the right; whereas its point is turned to the left, forwards, and downwards, as far as the level of the fifth intercostal space.

Thus placed in the anterior mediastinum, and retained in its position by the fibro-serous sac of the pericardium, in which it is enclosed, the heart reposes below, upon the muscular partition which separates the chest from the abdomen.

The anterior border of the right lung, advances a little anteriorly upon the right portion of the pericardium, whilst the corresponding border of the left lung, advancing equally upon the left portion of the pericardium, covers almost entirely the left cavities of the heart. The portion of the heart therefore which is not ordinarily covered by the lungs, belongs principally to the right cavities of the organ, and particularly to

two thirds of the anterior surface of the right ventricle. This space presents the figure of a lozenge, and may be from an inch and half to two inches square. The number of persons in whom the lungs cover completely the pericardium is exceedingly small.

The heart is formed of two symmetrical halves, and, if the expression be allowed, of two hearts united; the one to the right anterior and inferior, the other to the left posterior and superior. This division of the heart is marked exteriorly by a slight depression passing along its surface, which is permeated by the coronary vessels. Another deeper furrow, which is circular, divides the heart transversely into two unequal portions, called auricles and ventricles.

The heart is therefore truly a double organ, and is composed of four cavities, viz. two auricles and two ventricles, the latter representing the body of the pump, while the former constitute the reservoir. Each is composed of one auricle and one ventricle, which do not, in the healthy adult, communicate directly with the corresponding cavities of the opposite side.

The two ventricles form the principal part of the organ, constituting the two anterior or inferior thirds. The left ventricle is thicker, stronger, and more muscular than the right; from its base is given off the great aorta, while the pulmonary

artery originates from the base of the ventricle of the right side.

"The auricles surmounted at their anterior part by the appendices auriculares, receive the insertion of several veins; these being, for the right auricle, the superior and inferior venæ cavæ; and for the left, the four pulmonary veins. This relation of different parts of the heart with the large vessels, has caused the right ventricle to be called the pulmonary ventricle, and the left the aortic ventricle; the right auricle, the sinus of the venæ cavæ, and the left auricle the sinus of the pulmonary veins.

"The four cavities of which the heart is composed have parietes of unequal density. These cavities are so disposed, that in the adult the left and right cavities do not immediately communicate with each other.

"But the two cavities of each half of the heart communicate one with another, by means of an opening called the auriculo-ventricular orifice.

"The cavities of the ventricles, separated from each other by a common partition, present the orifices of the pulmonary artery and the aorta.

"These as well as the right and left auriculo-ventricular orifices, are furnished with membranous folds, designated under the name of valves. The aortic and pulmonary valves are three in

number for each orifice, and are known by the name of sigmoid valves, an appellation which gives a sufficiently exact idea of their configuration; they have also the name of semi-lunar valves. The free edge of each of these valves has in its centre a small body which is called the *tubercle of Aurantius*. The valves which are adapted to the auriculo-ventricular orifices have their free border indented by a great number of small denticulations, and are besides divided deeply into three principal tongues in the right ventricle, and into only two in the left. Owing to this arrangement, the appellation of tricuspid valve has been given to that which borders the right auriculo-ventricular orifice, and the name of bicuspid or mitral to that of the left. When these valves are raised, they close the orifices to which they are adapted in the same manner as the sucker of a pump.

"The auriculo-ventricular orifices, the circumferences of which are elliptical, whilst those of the orifices of the aorta and pulmonary artery are circular, are bordered by a whitish line or zone, which is more apparent on the side of the auricles, owing to the projection caused by a fibrous or tendinous ring enclosed in the substance of the heart itself.

"The cavities of the two ventricles do not offer exactly the same form; that of the right

being irregularly rounded and oval, whilst that of the left is concoidal.

"The cavity of the former is larger than that of the latter; but the last has greater height or length than the first.

"The cavity of the right ventricle not descending so low as that of the left, it follows that the point of the heart is formed really and entirely by the latter.

"The direction of the cavity of the right ventricle is not parallel to that of the cavity of the left ventricle; on the contrary, the axis of the former, if ideally prolonged, crosses at an acute angle the axis of the latter.

"But let us examine still more minutely the disposition of the cavity of each ventricle. It is an interesting point of anatomy, which our predecessors have scarcely touched upon.

"The cavity of each ventricle is composed of two very distinct portions; the one opens almost directly into the auriculo-ventricular orifice; the other, on the contrary, into the arterial orifice, which is situated at the base of each ventricle. These two portions of the ventricular cavity are not constituted altogether in the same manner on the right and left sides. In the right ventricle, the *pulmonary portion* (which we call thus, because it opens into the pulmonary artery) is united to the *auricular portion* (that which opens

into the auricle) by means of a kind of angle, the sinus of which is turned upwards.

"In the left ventricle, the aortic and auricular regions or portions are parallel to one another,* and take a vertical direction. They are separated from each other by the right or anterior lamina of the bicuspid valve, and by two large fleshy columns which go to be inserted there by means of numerous tendons. The auricular portion is situated below, backwards, and to the outside of this sort of partition, whereas the aortic portion, larger than the other, is placed above, forwards, and inwards. These portions communicate freely with each other at the interval which separates the voluminous columns mentioned above.

"The columnæ carneæ, or fleshy columns, exist in the auricular portion of each ventricle. Indeed a large portion of the aortic and pulmonary regions is without them. Even those which do exist are very small and reticulated, and do not go to be inserted into the valves, like the principal ones which exist in the auricular portions.

"The muscular fibres of the heart, by their

* Owing to the conical form of the ventricle, these two regions approach each other in proportion as they proceed from the base of this ventricle to its apex; they are not, therefore, exactly parallel.—(*Note of M. Bouillaud.*)

union in the form of fasciculi, form in the interior of the cavities of the organ those bodies which anatomists call the *fleshy columns* of the heart, which differ in their configuration according as they are examined in the auricles or the ventricles, or even in particular portions of these cavities. Thus they are much more marked in the ventricles than in the auricles, and are much more numerous in the right than in the left ventricle, although those of the latter are more voluminous than those of the former; again, the right auricle is provided with them to a considerable extent, while the left is supplied with them only in its appendix.

"Some of these fleshy columns crossing each other in all directions, give to the internal surface of the ventricles the appearance of a kind of net-work, the meshes of which are of different volume and the fibres of unequal size.

"Some of these fleshy pillars being detached from the heart at their middle portion, adhere to it only at their extremities, and by their contraction act like the string of a bow.

"Others again being free at one of their extremities only, give origin to a number of small tendons (*chordæ tendineæ*) which go to be inserted into the free edge of the auriculo-ventricular valves.

"M. Bouillaud is the first who has described

with accuracy the columnæ carneæ which he considers as true and special muscles whose function it is to raise the valves, after they have been depressed during the diastole of the ventricles, and also to close the orifices.

"Two of the columnæ carneæ projecting in the interior of the left ventricular cavity, sometimes as large as the little finger, have their origin from the numerous fasciculi at the posterior wall of the cavity, the one outwards towards the junction of the anterior surface with the posterior, where it goes to form the left border of the heart; the other inwards, a little on this side of the sinus, where the posterior surface of the ventricle becomes continuous with that formed by the interventricular partition. After having as it were taken root not far from the apex of the heart, the two columns which we describe direct their course from below upwards, and when arrived at nearly half the height of the ventricular cavity, they become entirely detached from the wall from which they had their origin, and terminate by a soft rounded extremity; the remarkable and almost constant arrangement of which has not been described by any anatomist.

"This extremity is divided into several fasciculi which afterwards unite so as to compose but two or three principal ones; they then, by turning, form a circle incomplete, that is to say,

hollowed on the side towards which the two columns are reciprocally turned. Of the two fasciculi, of which we have just spoken, the one is anterior or superior, the other posterior or inferior; each posterior fasiculus is somewhat shorter than the anterior, and is also rather less in size. From the anterior fasiculus of each column arise several tendons, which go to be inserted into the interior lamina of the bicuspid valve. The angle formed by the reunion of the two laminæ of this valve is also provided with tendons so arranged that the whole elliptical arch of the valve is furnished with tendinous fibres, which are subdivisions of those which we have mentioned as arising from the extremity of the double terminating fasiculus of each column.

"At the point where the two columns terminate by separating into fasciculi, as already noticed, they leave between them, when the cavity of the ventricle is dilated, an interval of eight, ten, or twelve lines; whence it follows that, in this point, the tendons of these columns are at a considerable distance from each other, whilst by reason of their reciprocal convergence towards the middle of the border of the lamina of each valve, they quickly approach each other, and their sides nearly touch at the point of their common insertion. It results from this arrangement that nothing can be more regular than the

manner according to which the mitral valve receives the tendinous fillets of the anterior lamina, whilst those of the posterior lamina are sent to it from the columns already described. Each of these columns is inserted into only half of the corresponding double lamina of the valve.

"The right column, as also the tendons which arise from it, are in general a little more voluminous than the left column and its tendons. I have tried two or three times to count the tendinous fibres with which the mitral valve is furnished, and have found their number to be about twenty-five.

"There arises also from the sides of the columns which we are describing, and from some others which are much smaller, a certain number of thin tendinous fibres, which cross the ventricular surface in an opposite direction, the insertion of which is not in the mitral valve, but in the walls of the ventricles themselves.

"In the interval which separates the two *levator* muscles of the bicuspid valve, there exist some fleshy fasciculi which pass transversely from one to the other, and which appear designed to approximate them, or at least to fix them in their position.

"Besides the two principal columns which we have described, there are found in some subjects, others which are much smaller, and which are

inserted by tendinous fibres into the circumference of the mitral valve; but even in these cases, the columns of this latter description do not seem really to be any thing else but *adjacent appendices* of the two principal ones.

"When the two laminæ of the bicuspid valve are depressed and separated from each other as much as possible, as is the case when the blood penetrates from the auricle into the ventricle, the fleshy columns which are there attached in the manner mentioned above, have evidently the effect, by contracting during the systole, to replace the depressed laminæ of the valve, since they draw them at all points from the circumference to the centre. It is then with reason that I have designated these muscular columns as *tensor elevator* or *adductor* muscles of the mitral valve. In consequence of the movement of approximation which these columns impress upon the opposite laminæ of the bicuspid valve, the left auriculo-ventricular orifice is exactly, and as it were hermetically closed.

"When the laminæ of the valve are once thus united, they become immoveable during the whole of the time that the contraction of their columns lasts, and cannot be inverted or depressed upon the parietes of the auricle by the effort of the blood which presses on every part of the contracted ventricle.

"Besides, when the levatores of the mitral valve contract, their corresponding surfaces in some sort approach: in fact, during this contraction, all the left or auricular half of the left ventricle is almost entirely obliterated; whereas the other half launches into the aorta the column of blood which it has received from the left auricle.

"This portion then is a sort of sinus or strait which leaves a passage to the blood during the dilatation of the ventricle, and which closes during its contraction by the mechanism explained above. It is in the interval which separates the two principal fleshy columns designed to move the bicuspid valve that exists, as already noticed, the communication of this portion of the ventricle with the aortic portion.

"The fleshy columns of the right ventricle are more numerous but less voluminous than those of the left; they do not take exactly the same direction, nor have they the same arrangement. Those which go to be inserted by their tendons into the free edge of the tricuspid valve, are more than two in number; among them are distinguished three principal ones. They are not divided at their extremity, like those of the left ventricle, into fasciculi which distribute their tendinous fillets to the two opposite laminæ of the valve. The tendons of these three principal

columns take the same divergent direction as those of the columns of the left ventricle.

"Besides the tendons furnished to this valve by the three columns already mentioned, it receives others from small columns dispersed here and there at the surface of the ventricle; there are others also which arise immediately from the parietes of the ventricle, near the circumference of the right auriculo-ventricular orifice.

"Moreover, the columns which thus furnish tendons to the tricuspid valve, have evidently the same functions as those which act in an analogous manner with regard to the bicuspid valve; they constitute in fact the *levator* or *tensor* muscles of the tricuspid valve. These muscles, by contracting when the three laminæ of this valve are depressed, draw them from the circumference to the centre by every point of attachment, and by this mechanism the right auriculo-ventricular orifice is perfectly closed. The columns and their tendons prevent the valve, when thus situated, from being depressed on the side of the parietes of the corresponding auricle."

We here close the description of the centre of circulation; the ideas which we have given are sufficient for the comprehension of the acoustic phenomena presented by the action of the heart.

We think that our readers will approve our judgment in having quoted the above passage

verbatim from the excellent work of M. Bouillaud, and particularly the description of the mechanism of the action of the valves, which performs so important a part in the formation of the different sounds of the heart.

## *Physiology of the Heart.*

The function of the heart, like that of every muscular organ, consists essentially in its movements. These movements, the causes of the sounds which we are about to examine, are those of a suction and forcing pump, which distributes over the whole body the nourishing fluid.

The movements are of two kinds. The first are manifest to the touch and inspection of the heart externally; they are the alternate contraction and dilatation of the ventricles and auricles, or of the reservoirs and chambers of the pump.

The second are concealed, and only occur in one part of the cavities of the heart; it is the play of the valves, which are real organized *suckers* of this beautiful living machine. They accompany the ventricular movements of which they are but the consequence. M. Bouillaud calls them *mouvemens valvulaires*.

During these different actions, the double sound of the heart may be heard, analogous to the tic tac of a watch, or *claquement* of the

suckers of a pump in action. The noises are called valvular noises (bruits valvulaires) by the Professor just cited.

The name of *systole* is given to the contraction of the ventricles and auricles, and that of *diastole* to their dilatation. It is by these movements that the ventricles fulfil the office of the chamber of the pump and the piston.

The movements of the auricles are only slightly sensible, and are not propagated to the other parts of the heart, whereas those of the ventricles are very energetic, and cause locomotion in the whole organ; thus, when allusion is made to the repose or motion of the heart, it refers to the state of the ventricles only.

The principal of these actions is without question the systole of the ventricles, and particularly that of the left; it constitutes the active state of the heart, and is accompanied by a phenomenon not presented by the other three, which is the shock or impulsion of the point of the organ against the parietes of the chest between the fifth and sixth ribs. It produces a tremor in the precordial region, which is sensible to the touch.

During the diastole, the heart retires from the parietes of the chest.

These four movements of systole and diastole follow each other and recur periodically. Each

series of actions, or so to speak, each revolution of the heart, includes a contraction of the ventricles, and consequently an impulsion of the point of the heart against the walls of the chest. The revolutions are counted by the number of impulsions; indeed they might be reckoned by any other of the heart's movements, provided they were sensible at the precordial region. The number of impulsions against the walls of the chest may also be estimated by the arterial pulsations with which they correspond.

The valvular movements consist in the successive depression and elevation of the auriculo-ventricular and arterial valves during the systole and diastole of the heart.

The movements of depression and elevation of the first coincide with the inverse movements of the second. After having examined each movement in particular, we shall next consider the manner in which they are linked together.

All these phenomena are subordinate to the contraction and dilatation of the ventricles, in the same manner as in a pump the depression and elevation of the piston determine all the other movements.

The following are the principal effects of the systole and diastole of the ventricles.

*Diastole of the Ventricles.*—The ventricles, by dilating, draw the blood from the auricles into

their cavity, and the blood cannot pass from the auricles into the ventricles without the auriculo-ventricular valves being depressed. The afflux of blood, by producing the distension of the ventricles, provokes their contraction.

*Systole of the Ventricles.*—The ventricles cannot contract without pressing on all sides the mass of the blood which distends them. This mass, seeking an outlet on every side, would at once escape by the auriculo-ventricular and arterial orifices, were it not that they are elevated by the contraction which has already taken place; the blood being repulsed at this point, is forced to escape by the arterial orifices, the valves of which it depresses. When once expelled, it cannot return into the ventricles, since in retrograding from the arteries towards the heart, it tightens the valves, and thus, if I be allowed the expression, it shuts the door upon itself.

The movements of the auricles do not act a very important part in the discharge of the functions of the heart; their office is in great measure that of a reservoir, which receives the liquid from particular pipes to transmit it to the chamber of the pump. Their systole is an additional cause which favors the passage of the blood into the ventricles, but this movement is very feeble, as may be imagined from the absence of valves at the entrance of the veins into

the auricles. It remains for us to become acquainted with the order of succession, in which the different actions of systole and diastole are executed.

The following are the results of experiments made by Dr. Hope upon frogs, rabbits, and asses.

"After its movement of dilatation, the ventricle rests in a state of relaxation, which is regarded as the repose of the heart.

"The first movement of the heart which interrupts the interval of repose, is the systole of the auricle. This systole consists in a very slight and short movement of contraction, more considerable in the appendix than elsewhere, which is propagated towards the ventricle by a sort of vermicular motion, the conclusion of which seems to be continuous with the systole of the ventricle.

"The ventricular systole commences suddenly, and is followed by the diastole. It is apparent to the view and touch, that the contraction of the ventricle consists in an energetic and sudden jerk, accompanied by the depression of the centre or body of the ventricle. The shock of the point of the heart against the parietes, and the pulsation of the arteries nearest the heart, are isochronous with the ventricular systole; the pulse of the arteries, at some distance from the

heart, as for instance, the radial follows the ventricular contraction at an interval scarcely perceptible.

"To the systole of the ventricles succeeds their diastole, during which they return, by an instantaneous expansion which is sensible to the touch and sight, to the state in which they were during the repose.

"The movement of the diastole is accompanied by a slight retraction of the auricles, and by the retirement of the point of the heart from the parietes of the chest; next follows the interval of repose, during which the ventricles remain in a state of plenitude without distension; after this state of quiescence, commences with the most perfect regularity the series of movements mentioned above."

The sum total of these movements, from the instant of the contraction of the auricles inclusively, to the return of the same contraction exclusively, occupy about one second in the adult.*

This space of time is naturally divided into three periods; the duration of each has been fixed as follows by Laennec, and verified by Dr. Hope.

* This takes place in rather less time than is stated by our author, as the pulse of a healthy adult at puberity beats from seventy-three to seventy-five strokes per minute.—(*Transl.*)

*First period.*—Systole of the ventricles, half a second.

*Second period.*—Diastole of the ventricles, quarter of a second.

*Third period.*—Interval of repose of the ventricles, quarter of a second.*

We proceed to the consideration of the rhythm of the heart. By rhythm is understood,

1. The relative duration of the successive pulsations of the heart.

2. The order in which each complete pulsation, or each revolution of the heart, presents the two movements of systole and diastole, and the repose of the ventricles.

3. The absolute duration of each complete pulsation.

4. The respective duration of each of the three periods, relatively with the total duration of a single pulsation taken for unity.

Such are the different circumstances of the movements of the heart, as far as concerns its rhythm; they are far from being uniform in their character; some of them vary according to the

* According to this estimate, there would remain no particular interval for the systole of the auricles, which Dr. Hope notwithstanding places separately. It is true, that he declares that this instant is short. But however brief it may be, still, since it precedes the contraction of the ventricles, and as the entire second passes during their movement and repose, its instant ought to coincide with the end of the time assigned to the repose of the heart.

age, the sex, and idiosyncrasy of individuals. Agitation, running, and passion impress on them passing modifications.

There are other derangements which are not observed, except in a morbid state, and it is only by auscultation that the majority of these latter can be discovered.

In order to enable the reader more easily to embrace all the elements which may concur in the formation of the sounds of the heart, and to discover the causes on which they depend, we will recapitulate the principal phenomena produced by the discharge of the functions of the heart, during each of the three periods which compose an entire pulsation, and assign to each of these periods those phenomena with which it coincides, or in other terms, we shall collect together all those phenomena which are synchronous.

Duration of one pulsation, one second.

*First period*, half a second; systole of the ventricles, and diminution of the cavity of the ventricle.

Synchronism; sliding of the heart against the pericardium; shock of its point against the parietes of the chest; quivering of the parietes of the thorax in the precordial region, sensible to the touch, the sight, and the ear; impulsion and friction of the parietes of the ventricles against

the blood; collision of the sanguineous molecules; elevation and tension of the auriculo-ventricular valves; impulse of the stream of blood against the auriculo-ventricular valves, and slight elevation of the redressed valves against the sigmoid valves, and depression of these valves projected by the blood against the parietes of the arteries; expulsion of the blood by the arterial orifices, and friction of the fluid against the inferior surfaces of their valves and the parietes of the arteries; arterial pulsation; diastole of the auricle during the first half of this period; state of relaxation of this part during the remaining half.

One of the sounds of the heart corresponds with this first half of the period of a pulsation.

*Second period*, quarter of a second. Diastole of the ventricle; enlargement of the ventricular cavity.

Synchronism; sliding of the heart against the pericardium; retirement of its point from the parietes of the chest (without any sensible parietal shock); depression of the auriculo-ventricular valves; afflux of blood from the auricles into the ventricles; friction of the tendinous ring which borders the open orifices, against the superior surfaces of the depressed valves, and against the ventricular parietes; collision of the particles of blood; closing of the arte-

rial valves immediately after the contraction; reaction of the arterial parietes upon the blood expelled during the contraction, and the returning shock of the blood against the sigmoid valve which it closes; state of relaxation of the auricles.

The other sound of the heart is heard during the dilatation: it is not separated from the first, except by an almost imperceptible interval of silence.

*Third period*, quarter of a second. Repose, or state of relaxation of the ventricles, finally followed by the contraction of the auricles. Passage of the blood from the auricles into the ventricles; occlusion of the arterial orifices.

### *Auscultation of the Heart in a healthy state.*

Each complete pulsation of the heart presents when ausculted, two successive sounds, one of which corresponds to the systole, the other to the diastole of the ventricles.

The nearest term of comparison that can be given to these sounds is the *tic tac* of a watch, or the double clack of the sucker of a pump.

The first sound is generally dull, less striking, and more prolonged than the other. It is easy to recognise that it is isochronous with the impulsion of the point of the heart against the

parietes of the chest, with the arterial pulsation and consequently the systole of the ventricles.*

The *second sound*, shorter, but clearer than the first, corresponds to the diastole of the ventricle; Laennec has compared it to the noise made by a dog lapping, and to the noise of the valve of a pair of bellows. Its resemblance to the latter is in fact much greater than to the former of these sounds.

The *tic tac* of the heart is heard much better in individuals who are thin and nervous, than in those who are fat and plethoric; but it is impossible to indicate all the shades of difference which it may present, according to the age, sex, idiosyncrasy, and state of calmness or agitation of different persons: there are some shades which will not admit of a precise description, and which experience alone can appreciate.

When the pulse is quick, these two sounds succeed each other with so much rapidity, that they seem to take place rather simultaneously than successively; they are however in fact distinct, and the ear can always distinguish both sounds. If the pulse be slow, it can even detect a slight interval of silence between them.

* If there exist any interval between the pulsation of the arteries at a considerable distance from the heart, and the sound in question, this interval is scarcely appreciable. M. Rigeau affirms that the first sound, which he calls *bruit inferieur*, is isochronous with the dilatation of the ventricles.

To this double sound, succeeds a longer period of silence, corresponding to the repose of the ventricles. Like the first interval, this period of the absence of sound is long in proportion as the contractions are less frequent.

It is rare that the resonance of the sounds of the heart is confined to the precordial region; in lean subjects, in those whose chests are narrow, and even in infants, these sounds are heard in all the regions of the chest, even in the right posterior portion. They are even very well heard upon the lateral portions of the neck.

This transmission of sound takes place across the parietes of the chest, and the organs which they contain; if these different parts were endowed with an equal conducting power in all subjects, the intensity of the noises of the heart might be estimated by the extent over which they were heard on the surface of the chest; but there are a number of circumstances independent of the heart, such as the leanness and embonpoint of individuals, or the existence of organic affections, which change the capacity of the organs for conducting sounds, and thus prevent us from taking advantage of this theoretical point of view.

The sounds of the heart are occasionally increased to such a degree of intensity in certain transitory palpitations, that they may be heard

at some distance from the walls of the chest. In general, the sounds of the pulsations of the heart diminish gradually in proportion as the examiner is removed from the precordial region. The first sound has its maximum of intensity immediately below and a little external to the nipple, at the point corresponding to the auriculo-ventricular orifices and valves; the other, on the contrary, is heard better above and to the inside of the nipple, at the point corresponding to the sigmoid valves.

But the differences of density and elasticity of the chest in different points, rendering the conducting power unequal, frequently displaces the seat of the maximum of sound.

The vibration which the impulsion of the point of the heart impresses upon the walls of the chest is sensible to the ear, like every movement which can be perceived by the touch.

Different theories have been proposed for the explanation of the normal sounds of which we have been treating: we will briefly state them in the order of their antiquity.

### *First Theory.*

The most ancient, that which is found in the works of Harvey, Senac, Haller, Bichat, and particularly Corvisart, attributes the sounds of

the heart to the successive contractions of its muscular fibres.

Laennec embraced the received opinion, which appeared to him to be sanctioned by the experiments of Wollaston and Erman, upon the sound produced by muscular fibres during their contraction.

The author of Auscultation thought that the first sound depended upon the contraction of the fibres of the ventricles, and that the second sound originated from the contraction of the fibres of the auricles. At a later period, the experiments of Dr. Barry having demonstrated that the auricles are almost immoveable, and that they remain in a state of constant dilatation or plenitude, Laennec had recourse to the contraction of the appendices of the auricles, to account for the second noise of the heart.

According to Laennec, the ventricular systole which is the cause of the first sound, is the first movement. The second movement is the ventricular diastole, which coincides with the systole of the auricle, which is the cause of the second noise.

Next intervenes the period of repose or state of inaction of the ventricles.

It would be too tedious to point out all the errors of a theory which reposes on data that are purely hypothetical. The inductions of

analogy are too uncertain, especially when they are not supported by other collateral proofs.

And even if it be not an abuse of analogy to refer the sounds of certain muscles, during their contraction, to other muscles, (the reality of which is not supported by fact,) it is at least to place a false estimate upon proofs of this nature, which admit the induction without being corroborated by other testimony.

Again, those muscles which render sounds during their contraction, never produce, in the opinion of Laennec, a phenomenon analogous to the *tic tac* of the heart; it is rather a *rotatory noise* similar to the distant rumbling of a carriage, as any person may satisfy himself by applying the ear to the wrist and clenching forcibly the fist. A noise called the *bellows sound*, analogous to that presented by the heart and arteries in certain affections, may be observed by placing the ear upon a pillow, and alternately contracting and relaxing the masseter muscles.

### *Second Theory.*

M. Pigeaux subsequently advanced another opinion. According to him the sounds of the heart depend upon the shock of the blood against the parietes of this organ and the large vessels, and that the contraction both of the auricles and

ventricles is nothing more than a simple coincidence, and does not concur except mediately to the formation of these sounds.

The following, according to M. Pigeaux, is the ordèr of the movements of the heart:

The blood having arrived in the auricles, dilates them without producing any sound, they then contract silently and propel the fluid against the bottom of the dilated ventricles, the walls of which vibrate and render the first sound, called by M. Pigeaux "*lower noise.*"

To the first sound succeeds a silence very short, having for its measure the instant of the contraction of the ventricles. The blood being expelled from the ventricles by this sudden contraction, next strikes against the base of the pulmonary artery and aorta, and this occasions the second sound, "*superior noise.*"

To the second sound succeeds the repose remarked by Laennec, followed by the noiseless contraction of the auricles with which the same movements recommence. This aphonious interval, which separates the sounds of two pulsations, has been more exactly denominated by M. Pigeaux the state of *silence.*

The author successfully combats the ancient opinion: analogy enables him to contest the formation of the sounds of the heart by the contraction of its fibres, when the contraction

of the most voluminous muscle, as the glutæus maximus, never produces a sound so high in the gamut as the noises of the centre of circulation.

Moreover, he adds, when the ventricles contract, the heart is filled with blood, and it is not therefore either this reaction, or the concentric shock of the parietes of the heart against the liquid it contains, which is capable of producing an elevated sound.

This conclusion is supported by the following experiment:—If the hand be plunged into a sonorous vase filled with liquid, the sudden and energetic contraction of the hand causes no noise, whereas the liquid which the hand may contain, being projected by jerks against the parietes of the vase, draws forth sounds from them. It is therefore to the eccentric reaction of the fluid contained within the heart against its parietes, that we must attribute the first sound.

To prove that the first sound is really formed in the bottom of the ventricles, M. Pigeaux maintains that the points where the sounds of the heart offer their maximum of intensity, are always at a distance of two or three inches from each other.

This circumstance is, however, far from being constantly the case, as M. Bouillaud has re-

marked. It is known, besides, that these points can be displaced, be drawn nearer or separated farther off, according to the different capability of the various parts of the chest for conducting sounds.

We might object to M. Pigeaux, that if the normal sounds of the heart were owing to the cause which he assigns them, they would remain the same, or nearly so, or at least, would not altogether disappear in important injuries of the valves.

Now it is not so, observes M. Bouillaud; in fact it is quite the contrary; for the injuries, of which we are speaking, particularly different kinds of indentations of the valves, cause the normal sounds of the heart completely, or almost completely, to cease, and occasion irregular noises, known under the names of *blowing*, *rasping*, *sawing sounds*, &c.

We do not wish to insist any longer upon the refutation of a theory which is maintained in opposition to positive facts; since it is undeniable and easily verified, that the first sound of the heart is synchronous with the ventricular systole.

### *Third Theory.*

Dr. Hope, in order to elucidate the researches respecting the sounds of the heart, has made

many experiments upon different animals, and particularly upon apes.

He first commenced by depriving the animals of sensibility and movement, by giving them a violent blow on the head, and afterwards carried on artificial respiration by means of a large bellows, the tube of which was introduced by an opening into the trachea.

After having taken this precaution, in order to diminish and render more regular the pulsations of the heart, he sawed through the left ribs near the sternum, and laid them back in such manner as completely to expose the centre of circulation.

The following observations were made by him:

1st. That the heart, distended or not, is always full.

2d. That the auricles contract first, though scarcely over their fifth part, and that their contraction is propagated to the ventricles, so that the contractions of these two parts of the heart resemble rather one continuous movement than two successive movements.

The ventricle which is constantly filled with blood, as we have already mentioned, becomes distended by receiving new quantities, which come to it from the auricles.

The distension of the ventricles quickly determines their contraction, the instantaneous effect

of which is the collision of the columns of blood and their breaking, which is additionally favored by the inequalities of the internal surface of the ventricles. It is to this collision of the columns consisting of the particles of blood that the first sound is due.

When the heart, once contracted, returns upon itself, the blood falls from the auricles into the ventricles, strikes their parietes, and produces the second sound.

Thus Dr. Hope assigns to the second sound the same cause as M. Pigeaux assigned to the "*superior sound.*"

The idea of the formation of the first noise by the collision or the shock of the particles of the blood is certainly ingenious, and it appears singular that, after having admitted this principle, Dr. Hope should have searched for another cause of the second noise.

The argument of M. Bouillaud against the hypothesis which attributes the formation of the first noise to the fall of the blood from the auricles into the ventricles, has the same force against that which places the formation of the second noise in the same movement. It refutes equally well the hypothesis of the formation of the first noise by the collision of the particles of blood.

We have above set forth the direct experi-

ments of Dr. Hope upon the rhythm of the heart.

### *Fourth Theory.*

Nearly about the time that the English experimenter published the results of his researches on the heart, M. Marc d'Espine proposed a theory altogether analogous to that of Laennec.

M. Marc d'Espine finds, in the mere action of the muscular parietes of the ventricles, during their movement of contraction and dilatation, the solution of the problem of the sounds of the heart, which Laennec attributed partly to the auricles, and partly to the ventricles.

The researches of M. Marc d'Espine upon the rhythm have brought him to the same results as those of Dr. Hope.

### *Fifth Theory.*

Another theory which is greatly in vogue at the present time is that of M. Magendie. This celebrated physiologist maintains that the first noise results from the percussion of the thoracic parietes by the point of the heart during the contraction of the ventricles, and the second from the percussion of the same parietes by the anterior surface of this organ during the dilatation of the ventricles.

The author alleges in favor of his theory :

1st. That in the cases of considerable effusions in the cavity of the pericardium, when the thoracic parietes are separated from the centre of circulation by the liquid, the sounds of the heart are not heard.

2d. That in cases of great enlargement of the organ by hypertrophy, these sounds no longer exist, because the heart has not sufficient room to strike against the walls of the thorax.

3d. That by removing the sternum in animals, the noises of the heart cease to be heard.

These facts, were they not disproved, would render the refutation of this theory difficult; it contains however many exaggerations.

We have often had occasion to examine patients who have been affected with pericarditis, accompanied with effusion, and yet the noises of the heart were always audible, though somewhat more obscure than in the healthy state. We have verified the same fact in cases of considerable hypertrophy of this organ.

Even though in the two cases just cited the sounds be somewhat less marked than in the healthy state, yet this difference depends upon the fact, that they are stifled by the presence of liquids, or by the thickness of the parietes of the ventricles. We are however far from denying the fact that the sonorousness of the parts sur-

rounding the heart has great influence upon the resonance of its noises, or that it may in certain cases even cause abnormal sounds, an example of which we will cite.

It is for this reason, that in animals of small stature, these sounds although strengthened by the surrounding parts, are only feebly heard; it is not therefore astonishing that if the sternum be removed they disappear altogether.

M. Bouillaud has however proved, by experiments, that this cessation of the sound is only an illusion. This celebrated professor states that he has distinctly heard the sounds of the heart in a cock and two rabbits, after the sternum had been removed.

We have also lately had the opportunity, in company with M. Descleaux, to observe them in a rabbit, although we failed in our attempt upon a cat a year since. Dr. Hope has been able to verify them upon five asses which were the objects of his experiments.

To these facts, which directly attack the basis of the theory of M. Magendie, we will add an observation which completely destroys it. It is as follows:

It has frequently happened to us to hear, besides the two normal sounds of the heart, a third noise arising from the percussion of the thoracic pa-

rietes by the point of the heart; it is not unfrequently met with in lean persons.

This latter noise, which we shall hereafter mention under the name of *metallic tinkling*, is essentially different from the natural sounds of the organ, and if it be incontestible that it is owing to the percussion of the chest by the point of the heart, it is impossible to assign the same mechanism to sounds which are altogether different in their nature.

### *Sixth Theory.*

A sixth and last theory has been proposed by M. Rouanet.

The following observations explain what this physician conceives to be the rhythm and mechanism of the noises of the heart.*

*First period, contraction.*—Immediately as the ventricle begins to contract, the blood, pressed on all sides, redresses the large valves, which are struck by their opposed surface. (The first sound is produced.) It then raises the sigmoid valves, escapes into the large arterial trunks, which it redresses, and into all the arteries, which it distends; hence the shock of the heart against the thorax, and the pulse.

* An Analysis of the Sounds of the Heart: a thesis sustained before the Faculty of Medicine of Paris, by M. Rouanet, 1832.

*Second period, dilatation.*—The contraction is scarcely terminated before the dilatation commences; a vacuum tending to take place in the ventricle, there is aspiration upon the two orifices; the arteries distended re-act upon the blood, which rushes against the sigmoid valves. (The second sound is produced.)

At the same time, the large valves are depressed by the blood coming from the auricles, and the ventricle is filled.

"The first sound," says M. Rouanet, "is heard at the commencement of the ventricular contraction. It is this which has caused the belief that this contraction was the cause of it. This noise is loud; it is in proportion to the energy of the ventricles; it is duller than the second; the valves which produce it are larger, and the parietes which receive it are also thicker."

The second sound is more distinct, because the valves are smaller, thinner, and are attached to walls which are more sonorous.

The shock, in the sense in which it is ordinarily understood, and which results from the collision of two bodies, cannot be, according to M. Rouanet, the only cause of the sound of the valves. He has discovered, by repeated experiments, that every membrane, passing from flaccidity to sudden distension, always yields a

sound, which varies according to the circumstances. Its intensity is in proportion to the causes which distend the membrane; its tone increases with the fineness and resistance to extension of the tissue of which it is composed: the size, thickness, and extensibility of the membrane render the sound more obscure. The auriculo-ventricular valves unite the most favorable conditions for the production of sound. They are thin, have the power of resistance, and are inextensible; they pass in an instant from the most complete flaccidity to sudden and violent distension, the result of the expulsion of the blood, and of the tension of numerous tendons which, from their ventricular border, go to be attached to the summits of several fleshy columns. Consequently, whether we consider in the valves a surface which dashes briskly against another surface, or see therein an eminently sonorous membrane subject to a strong and instantaneous tension, we shall be forced to admit that a sound perceptible to the ear exists at that point of the organ.

We can only observe, that the exposition of the theory of M. Rouanet, is the best refutation that can be offered of the preceding hypotheses. In fact, the valvular movement is without doubt as likely to produce sound as any of those mentioned and supported in the above-mentioned

theories. This fact is indeed proved, both by the experiments of M. Rouanet, and by those which we make daily with pneumatic or hydraulic pumps, the play of which offers so great an analogy with that of the heart.

On the one hand, the particular nature of these sounds bears such a resemblance to the *claquement* of suckers of different machines, that Laennec, whose opinion cannot be suspected in this case, has compared one of them to the noise made by the valve of a pair of bellows.

On the other hand, neither the muscular contractions and dilatations, nor the flow of blood from the auricles into the ventricles, nor the friction of the stream of blood against the parietes of the large vessels; the collision of the particles of blood, nor the percussion of the point or base of the heart against the walls of the chest, even were they capable of giving rise to sounds, could produce the double *claquement* of the valves or the tic tac of the heart.

But does not the pathological physiology of this organ give us direct and irresistible proof of the valvular sound? We extract the following from the work of M. Bouillaud on this subject.

"As long as the valves are capable of playing freely, whatever be the disease of the heart, it is not accompanied by a profound and radical alteration in the sounds of the heart; there

ensues only an augmentation or diminution, more or less considerable, of these noises. If, however, the alterations of the heart be such that the valves cannot play properly; if in fact these bodies become themselves the seat of disease, in these cases constant and deep alterations of the cardial sounds will be observed; indeed they will sometimes disappear entirely and be replaced by others, such as the *blowing*, *sawing*, *rasping sounds*, &c."

The theory of M. Rouanet, by showing under the same point of view the production of the normal and abnormal sounds, and by approximating as much as possible the mechanism of the first to that of the latter, offers a degree of unity and practicability alike satisfactory to the mind as useful in practice. It is for this reason that we have proposed to adopt it, as being worthy of confidence.

In coming to this conclusion, it would be in vain to deny that we have been greatly influenced by the fact that it has been also promulgated by M. Bouillaud, whose researches on the diseases of the heart are so excellent and so generally known.

This physician is however of opinion that M. Rouanet has shown himself somewhat exclusive in referring the first noise solely to the play of the auriculo-ventricular valves, and that in the

formation of the first sound of the heart, we should equally take into account the sudden projection of the sigmoid valves against the parietes of the aorta and the pulmonary artery. He is also inclined to believe, that the sudden depression of the auriculo-ventricular valves, which are synchronous with the closing of the sigmoid valves, have some influence in the formation of the second sound of the heart.*

M. Piorry has likewise made several experiments for the purpose of explaining the mechanism of the sounds of the heart.

This practitioner affirms that he has distinctly heard these sounds by directing a stream of water into the cavity of this organ, after having excised the valves; and he concludes from these experiments, that the intensity and perhaps the nature of the sounds produced in the heart, arise from a variety of causes:

1. The force and rapidity with which the blood is propelled.

2. The density of the structure of the heart.

3. Dimension of the orifices.

4. Diminution of the cavity by which the blood passes.

5. The rigidity or hardness of the heart which contracts.

* Traité Clinique des Maladies du Cœur en 1835, pp. 135 et 136.

6. The diminution which the contraction of the fleshy fibres may cause, in the kind of tube formed by the heart, and the passage of the blood through this organ.

We shall content ourselves with the mere mention of these facts without adding any comment.

## AUSCULTATION OF THE HEART IN A MORBID STATE.

### *Abnormal Sounds.*

If the play of the valves be the cause of the normal sounds, it is evident that the injuries which attack the conformation of these parts, or modify their action, will also affect the noises of the heart. On the other hand, if the movements which are isochronous with the play of the valves, such as the sliding of the heart against the pericardium, the striking of its apex against the parietes of the chest, the flow of blood against the walls of the ventricles, and against the surfaces of the valves; if all these movements, I say, be noiseless in a healthy state, they nevertheless contain the elements of sound, and these elements may be completely developed in injuries, whether organic or physi-

ological, of the centre of circulation, and produce new sounds in the precordial region.

Finally, the retrograde movement of the blood from the ventricles into the auricles, and from the arteries into the ventricles, which does not happen during the normal condition, may however occur in particular lesions of the valves: may not these circumstances produce abnormal sounds, as well as the other movements of the heart do in analogous organic changes? We shall presently see that all these inductions are proved; but let us first examine the simple modifications of the sounds of the valves.

It would be difficult, or rather impossible, precisely to determine the different normal and abnormal modifications of valvular sounds, whether as respects their intensity or their tone.

Nothing varies more than their intensity; sometimes they are so marked, that they imitate the distant clack of a mill, and can be heard at some distance; in other cases they are so slight, that they can be only distinguished by great attention.*

* Violent exercise; nervous agitation; fever; alcoholic stimulants; mental emotions, as joy, fear, and melancholy; indigestible food; or an impaired state of the assimilating organs, modify in a very striking manner, the sounds and movements of the heart, even where no organic lesion exists, showing to the physician the importance of an accurate acquaintance with all the facts connected with the cases submitted to his examination, before proceeding to the consideration of the variations of sound observable by auscultation.—(*Transl.*)

As a general rule, the sounds of the heart are more intense in proportion as the force with which the valves and ventricles act is considerable, and the tension of the valves augmented, since their density, and consequently that of the ventricles, is diminished.

The sounds of the valves offer sometimes a remarkable character, viz. a parchment-like tone (*timbre parcheminé*) analogous to the dry, harsh, and distinct clicking sound (*claquement sec, dur et clair*) of two sheets of parchment forcibly and briskly clashing against one another, and which, in the opinion of M. Bouillaud, coincides with a state of hyperthropy accompanied with rigidity of the valves.

At other times, the sounds of the organ are, on the contrary, rough, harsh, or stifled. According to the Professor from whom we borrow these details, the latter tone would coincide with a state of flaccidity of the valves, and is only an inferior degree of the *bruit de souffle*, the appearance of which it frequently precedes or follows. M. Bouillaud has moreover observed, that whenever this sound becomes changed to the *bruit de souffle*, it was owing to certain incrustations or vegetations on the valves.

But in all the modifications which we have cited, as in all those which do not hinder the tic tac of the valves from being heard, we may be

assured that the injuries of the valves do not prevent their free action. And reciprocally, whenever the injuries of the valves do not affect their movement, the noises of the valves will never be entirely obliterated.

The abnormal sounds, in case their formation be not incompatible with the free action of the valves, may therefore exist in the præcordial region, while those of the normal condition still remain. But as soon as the lesion of the valves prevents their free action, the natural sounds cease to be heard, and are replaced by others.

1. The abnormal sound which most frequently replaces the tic tac of the heart, is the *bruit de souffle*, the appearance of which frequently precedes the extinction of the noises of the valves. The *blowing sound*, (*bruit de souffle*,) properly so called, is only a modification of the generic *bruit de soufflet* or bellows sound of Laennec; the other varieties observed by this author, are the *bruits de scie* and *de rape*, ("sawing, grating sounds.") All these sounds have a common character with the preceding one. There is also the *sibilous sound* observed by M. Bouillaud, who regards it as only a higher degree of the *bellows sound*, and makes the same difference between them, as exists between blowing and whistling.

The *sawing*, *grating*, *blowing*, and *sibilous*

sounds are easily imitated by expelling the air with more or less force from the mouth half opened. There is, however, one species of the bellows sound which resembles the noise accompanying the inspiration of a small column of air rather than its expiration.

What is the cause of these different abnormal sounds? Laennec, who only took the absolute measure of the orifices of the heart, and who had frequently observed the blowing sound to exist in cases in which the real diameter of the orifices remained normal, came to the following conclusion, "that the abnormal sounds are not dependant upon any organic injury which can be detected as the cause of them."

The author of Auscultation, in wishing afterwards to explain the bellows sound by a simple spasm, has fallen into an error similar to that committed by many physicians of the present day, viz. in assigning to a nervous state any affection, of the nature of which they are ignorant.

If the organic dispositions and physiological conditions of the heart have furnished us with the physical causes of the sounds of the valves, let us not search elsewhere for those which are abnormal than in organic and physiological conditions of the structure.

A sound or vibratory movement supposes, ac-

cording to that analysis, two principles: 1st, the instrument of the vibrations, or the element which vibrates; 2d, the agent of the vibrations, or the moving power which provokes them.

The parietes of the heart, and particularly of the valves, perhaps also the blood, form the principal instruments, or seat of the vibrations: the chief agent is, however, the movement of the blood, resulting from the ventricular contractions and dilatations. It consequently follows, that every important modification of the conformation of the heart and of the movement of the blood, necessarily affects the noises of the organ.

This has been demonstrated by the most positive facts; the researches of M. Bouillaud have established the following results:

1st. That if organic contraction of the orifices be not the sole lesion which can occasion the *bellows sound*, it is at least the most frequent cause; indeed, so great is the proportion, that out of twenty cases in which this sound is observed, nineteen will present contraction.

2d. That in all cases this sound may be attributed to one and the same condition, viz. increase of friction during the passage of the blood through the orifices and cavities of the heart. It is thus that the *bellows sound* may be produced in an artery by compressing it slightly,

so that greater friction may be created during the passage of the blood

This sound will therefore be heard in all affections of whatever nature, which tend to increase the friction of the column of blood against the parietes of the orifices or the ventricles.

The following are the affections in which this sound has been noticed by the Professor alluded to:

1. In cases of coagulated blood, whether existing in the orifices or even in the ventricles.

2. In cases of contraction of the aortic orifice, whether congenital or produced independently of the state of the valves.

3. In cases in which, without contraction of the orifices, the valves, covered with vegetations or calcareous or cartilaginous incrustations, present an unequal surface, or, being flabby, cannot close exactly the orifices: first case of inability.

4. In two cases, in which without stricture of the corresponding auriculo-ventricular orifice, the auriculo-ventricular valves had adhered to the adjacent parietes, which, preventing the proper closing of the valves, produced a second case of inability.

5. In certain cases of dilatation of the auriculo-ventricular orifices, accompanied with

dilatation of the ventricles: third case of inability.

6. Sometimes, but not in a permanent manner, in cases of considerable hyperthropy of the left ventricle with dilatation of its cavity. In this case, the sound will be best heard after great fatigue, or after strong moral excitement.

7. Sometimes in chlorotic, nervous, or anemic patients this sound coincides with the attacks of palpitation.

8. In cases of profuse hæmorrhage.

Finally. The possibility of the formation of this sound may be theoretically admitted in cases of compression of the organ by effusion within the pericardium, or by the existence of a tumour.

It is evident that in all these cases, the affection produces an increase of friction.

In the two first cases, this increase is evident. In the third and fourth cases, the valves, not being able to close exactly their orifices during the dilatation, by reason of the inequality of their surfaces, permit the blood to flow back from the ventricles into the auricles, and this reflux through a narrow orifice would naturally produce more or less friction. The same is true of the fifth case, in which the circumference of the dilated orifices would draw outwards the base of the valves, and would no longer permit them to cover completely their orifices. In that case, the

blood flowing back from the ventricles into the auricles by the narrow orifice which exists between the free edges of the valves, would produce friction sufficient to produce this character of sound.

In the sixth case, the heart does not present any organic affection; but the energy of the ventricular contractions and the proportionate force with which the blood is propelled against the orifices, are sufficient to account for an increase of friction.

The cause of the occurrence of this sound in patients affected with chlorosis is contained in the fifth category. In fact, nothing is more common in these affections than to find dilatation of the ventricles accompanied with diminution of the density of the parietes.

Lastly, M. Bouillaud attributes the *bellows sound*, which is heard after profuse hæmorrhages, "to the convulsive rapidity with which a small column of blood is expelled by the heart through a cavity and orifice which have become very much contracted in consequence of the organ collapsing in order to accommodate itself as it were to the small quantity of blood which it receives."

It is then positively proved, that the *bellows sound* does not depend on one and the same affection; that many anatomical or even purely

physiological conditions may occasion it, provided that the conditions be capable of producing an increase of friction, which is the common element of all these sounds.

But among these different conditions, there are some which only occasion certain and invariable species of this *bruit*. Thus, observation has discovered that the *grating*, *sawing*, and *musical sibilant sounds* exist exclusively in cases of contraction of the orifices of the heart by induration of the valves; while, on the contrary, the *blowing sound* may be heard in all the affections which we have mentioned.

When this latter sound accompanies an organic contraction of the orifices, this stricture coincides (as Laennec has already remarked) with an induration of the valves, rather fibrous or fibro-cartilaginous than osseous, with a smooth rather than a rough state of the surface of the valves, with a slight degree of stricture, and with contractions and dilatations of the ventricles of moderate force rather than with energetic movements.

The circumstances under which the *rasping* and *sawing* sounds occur, are directly the reverse. These sounds are principally heard in cases of considerable stricture of the orifices, and indicate a rough and uneven state of the

surfaces of the valves; they also correspond with energetic movements of the heart.

The latter sounds arise either from the vibrations excited in the rough parietes during the passage of the blood, or from those excited by the column of blood itself as it breaks against the uneven surfaces.*

The *sibilant sound*, which we have already remarked, is nothing more than a modification or sharper tone of the *blowing sound*, also depends upon a contracted state of the orifices; it however occurs in cases in which this is more considerable than that which accompanies the other varieties of this sound. In fact, in one case in which M. Bouillaud has remarked this sound to be very distinct, he found at the autopsy so great a contraction of the left auriculo-ventricular orifice, that it resembles a fissure having only three lines in extent in its greatest diameter.

We should have before informed the reader that it is impossible in the normal state to distinguish the sounds which belong to the left half of the heart from those which are produced in the right; we cannot therefore assign to the re-

* The rasping sound is very closely imitated by the noise produced by the instrument from which it derives its name. Unlike the bellows sound, which frequently intermits, when once developed it remains as a permanent sign of the abnormal condition which it points out; it may vary in intensity, but is never entirely absent, and furnishes unequivocal evidence of disease of the valves.—(*Transl.*)

sonance of each of them a particular place in the precordial region.

But if an abnormal sound have its maximum of intensity below the nipple, there will be strong grounds for believing that it belongs particularly to the left ventricle; the contrary is the case if it be heard but upon the sternum.

However, this observation, which is far from being always verified, is not always applicable. In fact, the majority of injuries of the valves and the orifices are followed by hypertrophy of the ventricles; and as in the case in question, the primitive injury, and the consecutive hypertrophy, occupy but one ventricle; the other, which retains its normal character, will be as it were enclosed in that which is diseased, so that all the sounds which are heard, either upon the sternum or beneath the nipple, will appertain only to the latter and will offer no sensible difference between them.

Is it possible to recognise whether an abnormal sound belong to an affection of the auriculo-ventricular orifices and valves, or to that of the arterial valves?

According to M. Rouanet, the observation of the rhythm of the heart, and the determination of the parts of the precordial region where the sounds of the organ are heard most distinctly, will afford presumptive evidence upon this sub-

ject; for if the abnormal sound be heard during the contraction of the ventricles, the probability will be strong that the orifice of the aorta is affected.

This presumption will be corroborated if the abnormal sound be noticed towards the region in which the orifice of this vessel is situated.

However, the *blowing sound* occasioned by the reflux of the blood into the auricles, accompanies also the contraction of the ventricles; but in this latter case, M. Rouanet asserts that the abnormal sound will be heard more distinctly towards the point of the heart than towards the aortic orifice.

If the abnormal sound accompany the dilatation of the ventricle, it is probable that the lesion exists in one of the auriculo-ventricular orifices, and that the sound is owing to the passage of the blood through the affected orifice.

But the same movement of the heart may be accompanied by another abnormal sound, proceeding from the inability of the sigmoid valves to cover their orifices; still, by attentively examining the region in which the sound is most perceptible, we may with certainty determine that of its origin, as in the preceding case.

On the other hand, M. Bouillaud asserts, that the *blowing sound*, which is occasioned by the reflux of the blood through an orifice incompletely

closed, offers this peculiarity, that it takes place singly, either during the dilatation of the ventricles, when the sigmoid valves are those in which the aperture is imperfectly closed, or during the systole, when the imperfection is in the ventricular valves; whereas the *bellows sound* is frequently double in cases of organic contraction of a single orifice.

Besides the abnormal sounds which we have just reviewed, there are occasionally others which are heard in the precordial region which are not formed in the interior of the heart, but between the laminæ of the pericardium.

*Rustling sound (bruit de frolement.)*—This sound resembles that obtained by the rustling of silk or taffeta. It seems to take place immediately under the ear, and is diffuse; which distinguishes it from the *grating* and *sawing* sounds which depend upon affections of the valves or orifices of the heart, and with which it might be confounded.

The *rustling sound*, when it is very slight, seems to depend, according to the facts observed by M. Bouillaud, upon a peculiar state of the pericardium when its opposite laminæ, dry or slightly viscous, as happens in the incipient stage of pericarditis, are not yet lined with false membranes, or at least only begin to be so lined. These two opposite sides, or laminæ, during the

movements of contraction and dilatation of the heart, act in the same manner as two pieces of silk or chintz when rubbed together.

*New-leather sound.*—This sound, first observed by M. Collin, imitates perfectly the creaking of a new saddle. I have observed it once in the service of M. Bouillaud, and could not help admiring the just comparison of M. Collin. Its formation seems to me to depend upon the stretching of the dense and resisting false membranes during the movements of the heart. At least, such is the conclusion which might be drawn from the autopsy of the patient who presented this phenomenon.

*Scraping sound.*—M. Bouillaud gives this name to a sound which is similar to that produced by the scraping of a hard body, either cartilaginous or bony, against the surface of the pericardium. The patient in whom he observed the presence of this sound in the left portion of the precordial region, presented at the post-mortem examination a calcareous concretion, which raised the visceral portion of the pericardium exactly at the point corresponding to the portion of the chest where this sound presented its maximum of intensity.

*Blowing, rasping, and sawing sounds.*—These sounds, already noticed in the affections of the heart itself, may belong also to affections of the

pericardium. They are in the latter case produced by the friction of the two laminæ of the pericardium, covered with false membranes during the approach of the heart to the parietes of the chest. Similar sounds may be produced by rubbing the finger against a pane of glass slightly moistened.

The sounds accompanying affections of the pericardium, are distinguished from those which denote injuries of the valves of the heart by their being more superficial, and being heard over a more circumscribed space.

However, it is only by comparing them together in the same individual, when that is possible, that a correct idea can be formed of the difference which exists between them.*

The abnormal sounds of the heart are isochronous with the movements of that organ, whilst those of respiration correspond with the movements of inspiration and expiration.

* I had lately under my observation a patient, twenty years of age, subject to a chronic affection of the valves, with a complication of pericarditis, accompanied with false membranes. On ausculting the region of the heart, I found two species of sounds, one of which, the *blowing sound*, was deeply seated, and corresponded to the valvular region of the organ; the other was entirely superficial, and was similar to the noise produced by a saw, or that caused by the friction of two pieces of paper. The autopsy has since then, confirmed the diagnosis. Besides the induration of, and small vegetations upon the bicuspid valve, the visceral pericardium, or that next the heart, was covered with soft and uneven false membranes, presenting in a great measure the appearance of the tongue of an herbiverous animal.

Lastly, we should not omit to mention another sound which does not belong either to affections of the pericardium or the valves: it has been known since the time of Laennec under the name of *metallic tinkling*. This phenomenon results from the percussion of the parietes of the chest by the point of the heart during the systole of the ventricles. It is observed principally in thin persons who are nervous and subject to palpitations.

It may be very well imitated, as Laennec observes, by applying the palm of one hand against the ear, and percussing the back part of the head with the index finger of the other; under these circumstances, the ear perceives, besides the shock which resembles the slight blow of a hammer, the clashing sound which appears evidently to be propagated along the whole line of the finger. It may be still better imitated by placing the palm of one hand against the ear, and percussing the back of it with the fingers of the other hand. This comparison, for which we are indebted to M. Bouillaud, unites with the accuracy of description, the obvious nature of the mechanism.

The *metallic tinkling* does not prevent the two sounds of the heart from being heard.

## *Abnormal Rhythm.*

The abnormal condition of the organ which we are considering, does not merely change the tone and intensity of its sounds, but produces also a deranged state of the rhythm.

This derangement may consist either in the rarity or frequency of its movements, or in their irregularity, or finally in their intermission.

It frequently happens that the movements of the heart are only accelerated or retarded without causing any irregularity in its pulsations. It is this which constitutes the *rarity* and *frequency* in these cases; it is ordinarily owing to the increase or diminution of the state of repose.

The irregularities or variations of frequency occur generally when the pulsations of the heart succeed each other after intervals of unequal duration. Sometimes they are constant. Sometimes they only recur from time to time, and offer a sudden variation of a single pulsation in the course of a series otherwise regular.

This sudden variation of a single pulsation differs from the false intermission in this, that the pulsation though shorter, is not however more feeble than the others.

These irregularities generally affect the complete pulsations of the heart; but sometimes they affect only one of its movements. Occa-

sionally, in cases of great derangement, the *first sound* of the heart will be prolonged in such manner as to mask the *second sound*, if it be feeble: again, it may be the *second sound*, which, stronger and more prolonged than ordinary, seems to anticipate the first sound.

When the systole of the ventricles is prolonged to an extraordinary degree, M. Bouillaud remarks that the pulsations of the heart appear to be lengthened or spun out.

It occasionally happens that two or three sounds are heard which are isochronous with the dilatation of the ventricles for one only of their contractions; these sounds succeed each other rapidly, so that they imitate tolerably well the *bruit de rappel* (recalling) to which M. Bouillaud has compared them. There exists also cases in which two or three systoles may be counted for one diastole.

Some of the irregularities mentioned by Laennec, in his treatise on Auscultation, have been verified by us, and though it may be easy to conceive of their production in different ways, yet it is difficult to assign them a precise cause.

*Intermittence* is the name given to a sudden and momentary suspension of the pulse.

Laennec gave the name of *true intermittent* to those intermissions in which the contractions of the heart are suspended as well as the arterial

pulsations. This species of intermission is a real arrest, a hesitation of the heart, and resembles a prolonged silence, so that if it alternate with each pulsation it would not differ from a slow pulse.

The false intermittent corresponds with feeble contractions, which are not perceptible in the arteries, but which may be observed by auscultating the precordial region.

The pulse frequently presents in this case, from time to time, a pulsation extremely feeble, instead of a total suspension.

The duration of the intermission is not uniform in all cases; sometimes it equals that of an entire pulsation; at other times, it is longer or shorter than this. Its return also is not subject to a fixed law; in certain cases, it supervenes after the second pulsation; in others again, it is not till after the tenth.

But in a given case, the order of recurrence is successive and regular, returning constantly after the same number of pulsations.

M. Bouillaud remarks that he has observed a species of false intermission, coinciding with a ventricular contraction which takes place, if the expression be allowed, when empty. This movement constitutes, according to him, a kind of *faux pas* of the heart, and seems to depend upon the fact, that the left ventricle in which it is ordinarily observed, not having been able to fill

itself sufficiently during the systole, (a circumstance not uncommon in cases of stricture of the auriculo-ventricular orifice,) contracts, if not exactly upon a vacuum, at least upon an exceedingly small quantity of the sanguineous fluid.*

## ARTICLE II.

## AUSCULTATION OF THE ARTERIES.

If the arteries be ausculted when in the normal condition, no other sound is heard except that which is produced by the shock of the blood against their walls. This sound is very obscure, varies in intensity according to the volume of the artery, according to the force and rapidity of the pulse, the age of the individual, the sex, and the constitution. It tolerably well resembles, as M. Bouillaud observes, the sound which is produced by rubbing lightly but briskly two fingers, one against another. It is the only

* The alterations in the rhythm of the heart are very numerous, but in many cases, this intermittent character of its movements denotes merely a feeble condition of the organs, as is frequently noticed after excessive hæmorrhage; in chlorotic patients; and in women affected with hysteria. When, however, the intermittence is marked, when it is long continued, and is unaffected by any remedial agents, the presumption is that it denotes some organic lesion, either hypertrophy of the heart; dilatation of this organ; or disease of its valvular apparatus. —(*Transl.*)

sound that is observed in the healthy state, and corresponds to each systole of the ventricles or each diastole of the artery.

Care should be taken not to confound the slight *blowing sound*, which accompanies each arterial pulsation whenever the artery is compressed by the stethoscope, with the natural sound of the pulsation. It is however merely an augmentation of the normal sound produced by the increased friction of the column of blood against the parietes of the compressed artery, and is simple and isochronous with the systole of the heart, like the normal noise.

This *intermittent blowing sound* may occur in the numerous affections where a large artery becomes compressed. M. Bouillaud, in one instance, has observed it in the left iliac region of a woman in whom existed an ovarian tumour, which compressed more or less considerably the iliac artery.

The other cases in which this sound has been noticed are:

1. The presence of an aneurismal tumour.

2. The presence of osseous or cartilaginous substances with or without contraction of the arteries.

3. The passage of arterial blood in a vein (aneurisma varicosum.)

4. Great agitation of the arterial system in emaciated enemic and chlorotic patients.

5. Pregnancy.

Fisher, an American physician, has lately read a paper before the Medical Society of Boston, in which he cites several cases, where he says he has observed the *blowing sound*, by applying the ear to the head of patients attacked with inflammation of the serous membrane of the brain. He has given to this phenomenon the name of *encephalic blowing sound*.

I have not as yet been able to verify this observation, which is an additional reason for bringing it before my readers.

Does its formation depend on the compression of the vessels of the brain, as Dr. Fisher thinks? We do not think that any other satisfactory reason can be assigned for it. This sound is much weaker, or ceases altogether, if the circulation in the carotids be obstructed; I should consider it to be a case of the *intermittent blowing sound*.*

*Continuous blowing and snoring sounds.*—M. Bouillaud has given the name of continuous blowing sound to a noise which is sometimes heard in the arteries, and which resembles tolerably well the blowing noise of the bellows of a forge. It accompanies both the systole and the

* Medical Magazine, No. 15; Journal hebdomadaire des Progres des Sciences, and Institutions Medicales, tome 11, No. 4, 1834.

diastole of the arteries, but though continuous, offers successive accessions of force, which resemble sudden jets or jerks. The increase of this sound corresponds to the contraction of the ventricles.

The *snoring sound*, or *bruit de diable*, as it is frequently called on account of its resemblance to the noise produced by a child's toy known under the name of *diable*,* is nothing more than a variety of the *continuous blowing sound*.

Sometimes the noise of the arteries resembles rather the cooing of pigeons, or even the whistling of air through a key-hole, than the continuous blowing sound.

The *bruit de diable* is most frequently observed in the carotid and subclavian arteries; less frequently in the crural, and never to the same degree as in the preceding arteries. Occasionally it is heard on both sides; in this case, it is more feeble on one side than the other; it is not however common to find it in the corresponding artery.

The sound disappears immediately on compressing the artery below the part at which it was heard. It also disappears by pressing the artery forcibly with the stethoscope, even though its calibre be not completely effaced.

* A double humming top, or double German top, which, when set in motion, produces the sound above referred to.—(*Transl.*)

The most remarkable circumstance however which attends this sound, is that it appears and disappears momentarily, without our being able to detect the cause of these alternations. Sometimes the mere change of position is sufficient to produce these alternations.*

*Musical sibilant sound.*—A species of musical sound is occasionally to be observed in the arteries. It resembles sometimes the humming of certain insects, as flies, bees, or the tones of a jews-harp. In one case in which I heard this noise, it would have been supposed that it was produced by a bee fluttering about in a still place.† All these sounds, with the exception of the *intermittent blowing*, are principally observed in persons affected with chlorosis.

During a year and half that I have attended the clinical service of M. Bouillaud, I have observed more than thirty times the *bruit de diable*, and have not seen a single patient affected with chlorosis, that has not presented this phenomenon. The frequent coincidence of these sounds with this disease, would lead to the supposition, that their existence depended upon a morbid alteration

* These subdivisions were made by M. Bouillaud. Laennec gave to all abnormal sounds, observed in the arteries, the generic name of *bellows sound.*

† By compressing the artery in which the *bruit de diable* is observed, this variety of sound may frequently be changed into the *musical sibilant sound.*—(*Transl.*)

of the blood peculiar to this affection. Experience corroborates this opinion. I have frequently seen this sound produced artificially after copious venesection, and again disappear when the blood had regained its qualities, after the use of tonic remedies.

Forming his opinion from the evidence of facts which exist upon this subject, M. Bouillaud thinks that the *bruit de diable* is most frequently met with in stout persons affected with chlorosis, whereas the *musical sibilant sound* is more generally observed, in those who are thin and of a nervous temperament.

What is the cause of all these abnormal sounds, of which we have just spoken?

A mere exposition of the cases in which the *intermittent bellows sound* occurs, will suffice for the comprehension of its mechanism. The essential element to its formation is *friction*, which produces the same effect as in the case of the *bellows sound* of the heart.

It is not so easy to explain the mechanism of the *continuous bellows sound*. However, if we observe accurately the state of the arteries in individuals who offer the different shades of this sound, it is impossible to mistake the modifications which take place in the tension and volume of the arteries, in the thickness of their parietes, as well as in the quality of the

blood which traverses their cavities. Thus we know, that according to the laws of physics, all these modifications would change the nature of the sounds which accompany the passage of blood through the arteries.

In addition to these general conditions, it is possible that there may exist particular circumstances which cause the sound to be more distinctly heard in one artery than in another. It is thus probable that the presence of the larynx and the trachea enables us to hear the *bruit de diable* and its modifications more distinctly in the carotid artery than elsewhere.*

We are still more inclined to adopt this opinion when we consider that, by causing the patients who exhibit it, to make a sudden or great effort, we can cause the phenomenon to disappear, as if by enchantment.

## ARTICLE III.

### APPLICATION OF AUSCULTATION TO PREGNANCY.

The introduction of auscultation into medicine has led to the discovery of an invaluable sign in the obstetrical art.

* The fact, however, that the *bruit de diable* may be heard in the crural and other distant arteries in chlorotic patients, proves that it cannot entirely depend upon the proximity of the lungs, in those cases in which it is noticed in the carotids, though it may reasonably be supposed to modify it.—(*Transl.*)

For a long time, the movements of the fœtus felt by the mother, the cessation of menstruation, united with the augmentation of the volume of the abdomen, and the swelling of the breasts, &c. were regarded as the most undeniable signs of pregnancy. But tumours of different descriptions, developed either in the uterus or parts adjacent, may produce amenorrhea, augment the volume of the abdomen, and cause the breasts to swell, inasmuch as they are linked by close sympathetic action with the womb. On the other hand, the pregnancy may be of nine months duration, and yet the mother may never have felt the movements of the fœtus; and it is not unusual to see hysterical patients who experience sensations analogous to those which we have mentioned above, without being in a state of utero-gestation.

M. Mayor, an eminent surgeon of Geneva, was the first who discovered that the movements of the fœtal heart might occasionally be heard; he did not, however, investigate the subject any farther, and it is to M. Jumeau de Kergaradec that we are indebted for its complete elucidation.

According to this latter physician, if the ear be applied, either with or without the stethoscope, to the abdomen of a female who has arrived at the middle term of her pregnancy, two distinct sounds may be observed:

1st. Simple pulsation, accompanied with a *puff*, or *placental sound.*

2d. Double pulsation of the heart of the fœtus.

The first sound corresponds, according to this physician, to the insertion of the placenta, and depends upon the passage of the blood through the vessels of the placenta.

Laennec was of opinion that this noise occurred in the branch of the uterine artery which serves for the nutrition of the placenta.

M. Ollivry, a physician of Quimper, has ascertained in four instances that this sound ceases immediately as the umbilical cord is cut, and is of opinion that it corresponds perfectly to the insertion of the placenta.*

The assertion of M. Ollivry is, however, not conclusive, and is opposed to the opinions both of Laennec and Bouillaud.† The latter considers the *blowing sound*, called placental, to be nothing more than the *intermittent bellows sound* of the arteries just mentioned, and that it is produced by the compression of one of the large vessels, as the hypogastric, or the external iliac, in consequence of the enlarged state of the uterus.

* Mémoire sur l'Auscultation appliquée á l'étude de la Grossesse ; by Le Jumeau de Kergaradec, 1822.

† See the letter of M. Ollivry to Laennec, in the Traité d'Auscultation of the latter.

Laennec thought this hypothesis inadmissible, because, if true, the placental sound should be heard on both sides of the uterus, either at one and the same time, or alternately, and might be made to disappear at pleasure by changing the position of the patient.

The objection that the sound cannot be heard on both sides does not avail, since cases have occurred in which this fact has been verified; besides, M. Bouillaud has succeeded in displacing the sound in a pregnant woman, by causing her to lie alternately on the right and left sides.

Finally, a fact which powerfully corroborates the opinion of this physician is, that the placental sound is sometimes heard in cases where tumours of morbid growth compress the large vessels of the abdomen; in one instance of this kind, the case was mistaken for pregnancy.*

These facts seem to us sufficient to refute the opinion of Laennec; for even though the sound be in general heard on one side, yet this may arise in consequence of the hypogastric and external iliac not being equally compressed on both sides. M. Paul Dubois is of opinion that the sound occurs in the vascular system of the uterine tissue.

The points at which it may be best heard are

* Vide Lancette Française, numero du 8 May, 1834.

the lateral portions of the abdomen. The double pulsation which is noticed on applying the ear to the iliac region of a pregnant woman at the middle of her term, is evidently due to the movements of the fœtal heart. A very exact idea may be had of this sound, by listening to the tic tac, or clicking of a watch, placed under a pillow on which the head is placed, or by ausculting the respiration of the smaller animals. The sound is marked or distinct in proportion as the fœtal life is advanced.

M. Bouillaud has remarked that the number of pulsations is in an inverse ratio to the age; he has noticed them as high as one hundred and seventy to the minute.

M. Paul Dubois says that the number of the pulsations of the fœtus is generally between one hundred and fifty and one hundred and sixty, independently of the age; but as M. Dubois himself allows that he has only made these observations upon women advanced in pregnancy at least six months, it is probable that the difference of the periods of pregnancy at which these distinguished physicians have observed the fœtus, is the sole cause of their difference of opinion.

The double sound of the fœtal heart may be heard at different points of the abdominal parietes; its pulsations, as observed sometimes by M. Dubois, gave rise to a *blowing sound* analo-

gous to that which is remarked in certain affections of the heart in adults. This celebrated accoucheur asserts, that it is owing to the mingling of the two columns of blood of the pulmonary artery and the aorta. This explanation, although purely hypothetical, is, nevertheless, exceedingly ingenious.

After what has been said of the placental sound, it will be seen that not much importance is to be attached to it as an unerring test of pregnancy.

It is altogether different with respect to the double sound of the pulsations of the heart of the fœtus. Whenever this sound is observable, we may be certain that the pregnancy is real, and that the fœtus is living, a circumstance of high importance in judging of pregnancy.

M. Bouillaud was called in to a female arrived at the seventh month of her pregnancy, and attacked with severe inflammation of the lungs. Her infant was living. On auscultation being practised, the sounds of the fœtal heart were heard, giving a hundred and seventy pulsations to the minute; symptoms of premature labour, however, soon supervened, and shortly after she was delivered of a fœtus which gave no signs of life. "The patient having ceased (observes he) to feel the motions of the child for many days, would naturally have led me to believe that the

fœtus had died before its birth, and thus to neglect the proper means for its resuscitation ; but from the fact that I had distinctly heard the pulsations of the heart, a few moments before the delivery, I instantly instituted frictions, plunged it into a stimulating bath, and inflated the lungs with air. After continuing these means for some time, I finally restored the infant to life ; it struggled, cried, and lived to the end of the day."

We will cite another case, which shows in a different manner the great utility of auscultation in pregnancy.

Some months since, I was summoned to a young female who declared herself pregnant for the first time, which she dated seven months back. She informed me that she had experienced all the signs of pregnancy ; cessation of menstruation, gradual swelling of the abdomen and breasts, and movements of the fœtus, but that, for the last month, all these phenomena had disappeared. I found her in the pains of labour. I attentively ausculted the abdomen, but could not distinguish the sounds of the fœtal heart ; this circumstance confirmed the opinion, which I had already conceived, of the death of the fœtus, owing to the facts stated by the mother. The delivery, which took place soon after, verified my conclusion.

Auscultation will, when considered in this

point of view, be of the highest importance in the prosecution of questions of a medico-legal character.

It may also throw much light, as remarked by Laennec, upon the diagnosis of multiplied pregnancy.

# PART SECOND.

## APPLICATION OF AUSCULTATION AND PERCUSSION TO THE DIAGNOSIS OF DISEASES.

## SECTION I.

### AFFECTIONS OF THE ABDOMEN.

We have already indicated, when speaking of the percussion of the thorax, the method of procedure in the exploration of the liver.

This organ, according to M. Piorry, is from two and a half to three inches in height towards the part nearest the sternum, four inches more outwardly, and four or five inches in the lateral region. Its transverse diameter is ten or twelve inches in length.

The knowledge of these limits, and of the means of determining them, renders easy the appreciation of the different morbid conditions of this organ, which are appreciable by the augmentation of its volume.

Thus, when in certain cases of acute hepatitis or congestion, either active or passive, the liver augments considerably in volume, we are able to determine accurately all its diameters by means

of *mediate percussion*, and watch, from day to day, the diminution in size, which rapidly ensues in some instances, after venesection. At other times, the hypertrophy is partial, and occupies only the left lobe of the organ, which, when thus affected, frequently extends nearly as far as the spleen.

In the case here alluded to, many practitioners finding pain and tenderness in the epigastric region, would attribute this condition to the existence of gastritis; but, by means of mediate percussion, the case would lose all obscurity, as this would at once discover to us, the dull sound of the prolongation of the left lobe of the liver superficially, and more deeply the *tympanitic sound* of the stomach.

In other cases, the intestines crowd the liver upwards, so that respiration becomes impeded. If the practitioner be not very familiar with percussion, he will frequently, in such cases, refer the dyspnæa to an affection of the lungs or the pleuræ; whereas an acquaintance with this method of exploration, will point out the total displacement of the liver, passing as much above its superior limit, as it is removed below its inferior border, and rendering the *tympanitic sound* of the intestines, above the edge of the false ribs; a position which they never occupy in the normal condition.

At other times, the superior border only of the liver rises, without displacing the other portions of the organ. This condition can be verified only by percussion.

The presence of effusion on the right side does not prevent the examination of the superior edge of the liver posteriorly. In fact, by placing the patient on the abdomen, the fluid will descend, and will leave the organ to be explored as though no such affection existed.

In those cases in which the quantity of effused fluid, is so great as to prevent it from gravitating, percussion would of course be of little service.

If the liver surpass the border of the false ribs, it is easy to determine its prolongation downward and to distinguish it from tumours.

Neither will the complication of ascites prevent the presence of the liver below the border of the false ribs from being discovered, since the *obscurity of sound*, and the *resistance* which it offers, are always greater than is afforded by effusion. If the patient be placed upon the back, it will be very convenient to depress, with considerable force, the abdominal parietes, so as to bring them in contact with the liver, or he may be made to lie upon the right and left sides alternately. These methods are particularly ap-

plicable to those cases in which the effusion is considerable. In fact, the weight of the liver will cause it to gravitate more completely to the abdominal parietes, if the patient be placed upon the right side, than in any other position.

It may happen in this case, that a fold of the intestines becomes interposed between the liver and the parietes of the abdomen; if grounds for this supposition exist, it will be necessary to repeat the percussion, taking care at the same time to depress the pleximeter with sufficient force, before adopting any conclusion. In this manner, the intestinal ansa or fold will be reduced to the density of a membrane, and will adapt itself to the surface of the liver in case it extend beyond the border of the false ribs, and thus will offer no impediment to a correct acquaintance with its condition.

In regard to the nature of different tumours which have their seat in this organ, percussion cannot furnish us with precise indications. However, if the tumours be superficial, the sensations of *elasticity* and of *feeble resistance* to the fingers, will enable us to distinguish abscesses from scirrhous masses, the characteristics of which are induration and considerable resistance. Hydatid tumours may sometimes be recognised by means of a vibratory sensation

experienced by the fingers, a fact already noticed in the commencement of the work.*

## SECTION II.

### DISTENSION OF THE GALL BLADDER.

In the natural condition, the gall bladder extends so little beyond the inferior edge of the liver, that itis impossible to recognise its presence by percussion. The case however is different when it is distended.

When the gall bladder is distended, the following is the method to be observed. The surface situated immediately below the inferior edge of the liver is to be percussed transversely; in the normal state, this region renders the *tympanitic sound* of the intestines; but when the gall bladder is distended, a slight obscurity or dulness of sound, without the sensation of resistance, will be per-

* According to the researches of M. Louis, in reference to organic lesions of the liver, a fatty degeneration of this organ is the abnormal condition most frequently met with. In general, it was connected with augmentation of volume, and occupied the whole organ. This lesion seems to be almost entirely confined to cases of Phthisis. Out of forty-nine examples collected during three years, forty-seven were affected with this disease. Sex seemed also to exert an influence in producing this organic change, as, of the forty-nine cases above alluded to, ten only were males, making the proportion between the sexes nearly as one to four.—(*Transl.*)

ceived at this region, and according to M. Piorry, the *humorique sound* may also generally be distinguished at the same time.

These signs succeed uninterruptedly the obscure sound of the liver superiorly, and soon give place to the *tympanitic sound* of the intestines in all other directions. These same signs, however, may be owing to the presence of liquids and gas contained in a fold of the intestines. If these characters continue without change at the same point, when the patient is placed upon the side, the presumption that they are due to the presence of the gall bladder will be changed into certainty, since, if they depended upon the existence of a fluid, they would be affected by a change of position.

## SECTION III.

### HYPERTROPHY AND ENLARGEMENT OF THE SPLEEN.

Enlargement of the spleen is of more frequent occurrence than true hypertrophy. It so frequently accompanies intermittent fevers, that of late this organ has been regarded as their point of departure. Without prejudging this question, the merits of which we consider as foreign

to our subject, we may at least be permitted to remark, that the enlargement of the spleen generally appears and ceases with the fever, and that whenever this condition of the organ remains, after the cessation of the fever, a return of the paroxysms should be feared, and the proper treatment, predicated upon this opinion, should be enjoined.

It will thus be seen, that a precise knowledge of the volume of the spleen, is a circumstance of great importance, and it is principally by the aid of mediate percussion that this can be obtained with any degree of accuracy.

If it be possible to detect certain cases of hypertrophy by the touch, where the spleen passes considerably below the border of the false ribs, it cannot however be applied to the cases of hypertrophy, which, though not frequent, are not however very rare where the spleen is prolonged upwards, instead of extending downwards. Again, in those cases in which this lesion gives rise to dyspnæa, and leads to the supposition that the lungs are the seat of the affection, it is only by mediate percussion that we can determine the nature of the complaint.

## SECTION IV.

### DILATATION OF THE STOMACH.

We have already observed, in the chapter on percussion of the thorax, that the mobility of the stomach prevented us from assigning to it any precise limits. However, with a little practice, the ordinary condition of the organ, cannot be confounded with an abnormal condition of it.

In this latter case, if the stomach be filled with gas, it will render the *tympanitic sound* over a more extended surface than in the natural state.

In some instances, the distension of this organ has been so great, that it has descended as far as the iliac region. In other cases of dilatation, the stomach, instead of descending, pushes the diaphragm upwards, and occasions great dyspnæa. More than once, percussion has discovered this condition of the stomach in affections which were supposed to be located in the respiratory organs.

## SECTION V.

### STERCORAL CONCRETIONS.

The intestines in general render the *tympanitic sound;* less clear, however, than that of the

stomach. This kind of sound is due to the presence of a greater or less quantity of gas; it however disappears, if stercoral matter accumulate, in great quantities in the large intestines, which produces great distress and derangement in the economy.

At times, these concretions or substances only produce simple obstruction, which can alone be detected by mediate percussion, and principally by means of the pleximeter. When this is practised, a dull sound will be observed in the region which corresponds to the accumulation of the fœces, and the fixed situation of this flatness of sound will easily enable the examiner to distinguish this condition from an effusion in the abdomen.

Sometimes the intestines, filled at once with liquid and gaseous matters, will yield the *hydro-pneumatic sound*. But since, according to M. Piorry, the same noise may be met with in the case of inconsiderable effusion, complicated with tympanitis, it will be of great importance to distinguish accurately between these two cases. This may be accomplished by changing the position of the patient, as recommended in the foregoing cases.

It may also happen that the fœcal matter may form globular concretions, and project externally. More than once, these concretions have been confounded with tumours of an altogether

different nature,* either with abscesses, the opening of which had been already determined on, or with agglomerations of the intestines, the sequel of peritonitis.

Again, the fœcal matter may, without causing an external projection, compress the nerves and adjacent vessels, and thus give rise to either sciatica, œdema of the lower extremities, or to symptoms of calculous nephritis. All these cases have been actually observed, and are stated at

* A case lately came under my observation, which illustrates the fact stated by our author. The patient, a lady, had suffered severely from an attack of jaundice, combined with enteritic inflammation, in Paris, during last August, from which, however, she entirely recovered. Shortly after leaving Havre, in November last, she became seriously ill, being attacked with violent colic, which induced spasms and incessant vomiting, and although subjected to the most judicious treatment, by an intelligent medical gentleman on board, found no relief. On her arrival in this city she was reduced to a mere skeleton; the vomiting continued without intermission, attended with fever and delirium. The patient had been twenty-eight days without having had an evacuation of the bowels, and on examining the abdomen, although extremely sensitive to the touch, a large rounded mass of scybalæ could easily be felt at the sigmoid flexure of the intestines. This, however, was soon removed by enemata; still the vomiting continued without cessation, although all the remedies used in such cases were exhibited; ice, though grateful to the patient, could not be retained. On attentively percussing the umbilical region, a tumour of considerable size was discovered, which, with the unabated continuance of the symptoms, the patient having been two weeks on shore, induced me to believe that the pylorus and mesenteric glands were diseased. By continuing however, the lavements in large quantities, a considerable mass of offensive stercoral matter was finally discharged, when the patient improved rapidly, and soon became convalescent.—(*Transl.*)

length, in a memoir which I have presented to the Faculty of Medicine at Paris.

It is principally by means of the pleximeter, that we are enabled to discover the original cause which gives rise to symptoms so varied in their character.

In those cases in which the fœces form projections, the fact may be verified by the sound, and the resistance of the tumour, compared with that of the adjacent organs. If it be the intestines, the history and symptoms of the case will lead to a correct knowledge of the affection.

Instances also occur in which the indurated fœces, though compressing the surrounding organs, do not cause any external projection ; in these cases the pleximeter, by depressing the abdominal parietes, will discover the presence of fœcal matter by the dulness of sound, and by the sensation of resistance which it offers. The knowledge thus obtained will render easy the appropriate treatment.

We had lately the opportunity to see, at the hospital of *la Charité*, a case of peritonitis in a female aged thirty-eight years, which was caused solely by the accumulation of stercoral matter.

This patient, enjoying in general good health, had at this period an icteric diathesis, which was very marked; for many days she had been affected with obstinate constipation. The ab-

domen was exceedingly painful to the touch, which sign, united with vomiting, a small pulse, and anxious countenance, left no doubt as to the existence of peritonitis.

But to what cause were we to trace its origin? Was it produced by cold, to which the patient, being a washerwoman, was much exposed? We were inclined to adopt this latter opinion, when we perceived a tumour, the percussion of which indicated its seat to be in the transverse arch of the colon. Its form was oval, it was free from attachments, and very hard; the patient assured us that she saw it then for the first time.

This circumstance, joined to the deficiency of stools for some days, suggested the idea of stercoral concretion, which by distending the coats of the intestines, might have given rise to peritonitis. But it became necessary to direct an immediate treatment against this latter affection. With this intention, local bleeding was twice prescribed.

The pain disappeared, as well as the other symptoms of the peritonitis, whereas the tumour remained.

This result corroborated our first supposition. Accordingly, by the administration of purgatives, copious evacuation was produced, and the tumour disappeared.

## SECTION VI.

### DISTENSION OF THE BLADDER.

In affections of the brain, in severe fevers, in cystitis, &c. it is not rare to see the bladder greatly distended with urine, although the patients are totally unconscious of it.

We frequently meet with this condition of the organ, and it is a circumstance which greatly aggravates the affection. This complication becomes especially dangerous when the physician's attention is not speedily drawn to it.

In order to prevent so grievous a circumstance, which might influence the result of the disease, the prudent practitioner will from time to time, interrogate the patient on this point, and will also examine the state of the organ by means of the catheter. It frequently happens, however, that the state of distension cannot be ascertained by the first of these methods, and the second, although it consists in an operation which is not in general difficult, is, nevertheless, often very painful, and may by frequent repetition produce inflammation of the bladder.

By the aid of mediate percussion, we are enabled to establish an exact diagnosis, without experiencing the inconvenience which the repeated

employment of the catheter would produce, while those cases in which the introduction of the instrument is necessary are easily distinguished.

In order to examine the bladder by the plexi-meter, the patient should be placed on his back, and the instrument be applied over the umbilicus, and at the same time somewhat forcibly depressed, in order to obliterate the intestinal fold interposed between the bladder and the parietes of the abdomen. It rarely happens that the urinary organ rises so high as here indicated, consequently the *tympanitic sound* of the small intestines is alone heard at this point: descending from it, however, in the direction of the linea alba, the dull sound of the bladder is soon encountered, which, if it be distended, is accompanied with a degree of resistance. These two characteristics continue to increase in proportion as we approach the pubis.

This examination should also be made on each side of the linea alba. If the *flatness* of *sound* be owing to the presence of the bladder, the points which indicate the passage of the *clear sound* of the small intestines to the *dull noise* of this organ, will not form a straight line, but a curved one, corresponding to the superior circumference of the bladder.

If on changing the position of the patient

from side to side, and continuing the exploration, the *flat sound* does not vary, we may be certain that it is owing to a distended state of the organ.

## SECTION VII.

### EXAMINATION OF EFFUSIONS IN THE ABDOMEN.

In order to recognise effusions in the abdomen, *fluctuation* is the method of investigation generally employed. But this method often gives obscure results.

Mediate percussion, and principally that with the pleximeter, will enable us not only to verify the presence of fluid in the abdominal cavity, but also to determine its level.

The method by *fluctuation* is practised by applying one hand to one side of the abdomen, and exercising with the other a slight degree of percussion upon the opposite side. If this be done, it will be found that the hand which is stationary upon the abdomen, will receive the shocks caused by the fluctuation of the liquid. This phenomenon is, however, often obscure, besides which, an analogous sensation is often perceived in persons who are very corpulent.

Some years since, M. Tarral proposed another

mode of examining these effusions, to which he gave the name of *circular fluctuation*. This method consists in applying the hand or index finger to one of the sloping sides of the abdomen, and with the other hand or index finger executing a number of shocks upon the parietes of the same side, in a circular direction.

During the percussion, the hand or finger which remains fixed will perceive the fluctuation of the fluid, as in the former method.

The fact that we have never been able to obtain any satisfactory results from this mode of examination might, we are aware, be attributed to our inexperience, or want of skill, were it not that a person of so much ability as M. Piorry has not been more fortunate than ourselves.

When the pleximeter is used, which is by far the preferable method, the examination should be commenced at the umbilical region. If there be effusion in the peritoneal cavity, the intestines being filled with gas, will rise to the surface in consequence of their specific gravity being less than that of the liquid; they will therefore be collected at the superior portion of the abdomen, in consequence of which the umbilical region will render the *tympanitic sound* of the alimentary canal.

The same sound will continue more or less inferiorly around the umbilicus, in proportion to

the height of the liquid. In order to determine precisely the level of the effusion, it is necessary to percuss gently the superior part of the abdomen. If the percussion be practised gently and without violence, when the pleximeter encounters the liquid, the parietes will yield a *dull, flat sound;* sometimes, however, the *humorique sound* will predominate instead, being produced by the shock of the fluid against the intestines. If, on the contrary, the percussion be exercised with force, the vibration communicated to the intestines will produce the *clear sound*, notwithstanding the small quantity of liquid which is interposed between them and the parietes of the abdomen.

Below this level, the quantity of liquid becomes greater and greater, and the *dull sound* increases in proportion; so that, by marking with nitrate of silver the transition of the *clear* to the *flat* or the *humorique sound* all around the umbilicus, we shall obtain a definite idea of the superior circumference or level of the fluid.

This examination, repeated from day to day, will verify mathematically the progress of the malady.

In order to assure ourselves whether the *flat sound* be owing to the liquid contained in the cavity of the peritoneum, it is necessary to change the position of the patient. In this case,

the *flat sound* will vary with the change of position, unless the effusion be very considerable.

If, on the contrary, the effusion be slight, it is more difficult to recognise its presence; there are, however, other methods which may be adopted when this is suspected. We have before said, that the cæcum yields the *tympanitic sound* in the normal condition. When, therefore, we have reason to believe that there exists slight effusion, the patient should be placed on the ileo-cæcal region, and if, while in this position, the *tympanitic sound* disappear, the presumption will be changed into certainty. Another mode is to cause the patient to lie upon the abdomen, in which position the liquid will gravitate to the umbilical region, and yield the *flat sound*, while under ordinary circumstances this position of the abdomen, would render only the *clear* and *tympanitic sounds*.

# CHAPTER II.

## AFFECTIONS OF ORGANS CONTAINED IN THE THORACIC CAVITY.

### FIRST ARTICLE.

### DISEASES OF THE RESPIRATORY ORGANS

## SECTION I.

### BRONCHITIS.

The name of bronchitis or catarrh, is given to the inflammation of the mucous membrane which lines the internal surface of the bronchi, throughout their whole extent.

At the commencement, this affection gives rise to no rattle. In fact, a degree of congestion of the mucous membrane of the bronchi, is the only change from the normal state which can be detected. May not, however, the cessation of secretion and the dryness peculiar to the first stage of bronchitis, as to all other inflammatory affections of membranes, exert an influence over the respiratory sounds?

We are not aware that any author has as yet drawn the attention of the profession to this subject.

By attentive observation, we have verified the fact, that at the beginning of bronchitis, the respiratory murmur is more rough than in the healthy state. This change in the respiration results from the friction of the air against the dry parietes of the bronchi. The same phenomenon is also observed at the invasion of eruptive diseases, and all other affections which offer a decided febrile movement.

At a later period, the secretory stage arrives, when the patient begins to expectorate, though not freely, white, viscid, and ropy mucus. The mucous membrane of the bronchi is as yet too sensitive, to suffer the matter to remain, and it is in consequence thrown off, in the same proportion as it is secreted, which does not, however, in general produce any abnormal sounds.

Yet, I do not think that the material thus secreted, is altogether unconnected with the production of those sounds, which are occasionally noticed during the first period of acute bronchitis: indeed, I am of opinion that it would be difficult always to explain the *sibilant rattle* which is sometimes observed at this time, by similar engorgement of the mucous membrane. It seems to me to be owing, in most instances, to a thin coating of viscid mucus which becomes attached to the internal surface of the bronchi, the cali-

bers of which are already more or less contracted by the congestion. The sudden appearance of this sound, and its instantaneous cessation after the expectoration of a small quantity of viscid mucus, seem to add proof to this supposition.

Whilst the *sibilant rattle* is heard at certain points of the chest, another sound, known since the time of Laennec by the appellation of *grave sonorous rattle*, may often be observed in other directions.

This latter sound is perhaps still more variable than the *sibilant rattle*, so much so that it is not unusual for it to disappear from those regions in which it had been verified but a moment before. If the *grave sonorous rattle* present itself at intervals only, and if it disappear after expectoration, it is very probable that it is owing to the vibrations of viscid mucus narrowing the bronchial tubes, or attached to the edges of a slight contraction of the bronchi, and that the engorgement of the mucous membrane is not as yet very considerable. It will be remarked, after what we have just said, that it is often difficult, at the commencement, to declare the existence of a bronchitis by the signs of auscultation alone, unless we repeat the examination frequently and at various periods of time after the slightest expectoration.

Percussion does not at this period throw any light upon our investigations; the air enters, in most instances, in sufficient quantities into the lungs for them to render the ordinary *clear sound*, as in the natural state.

The observations which we have detailed above, are applicable only to a slight attack of bronchitis; but if this affection become very intense, equalling a case of pneumonia in severity, and if the mucous membrane be much congested, then the *sibilant* and *grave sonorous rattles* may be satisfactorily explained, by recurring to the pathological condition which the disease gives rise to. These rattles are, under these circumstances, heard over a great portion of the thorax, and continue for a long time. The air cannot enter in proper quantity into the pulmonary vesicles, the respiratory murmur is scarcely heard, and percussion produces, in a more or less marked degree, *the dull* or *flat sound*.

When the material secreted by the mucous membrane of the bronchi is more copious, and the expectoration is not proportionate to the quantity formed, the displacing of the mucus during the passage of the air occasions a particular sound, which we have already noticed under the name of *mucous*, or *humid bronchial rattle*, which is heard equally well during inspiration and expiration. It may also give rise to

the *subcrepitous* rattle, if the displacement of the mucus take place in bronchi of small calibre; this latter resembles still more the crepitous rattle of pneumonia, inasmuch as it is dry, and heard during inspiration only. It frequently happens that the union of the abnormal sounds of respiration in bronchitis, closely resembles the cooing of doves, or the noise of a carpenter's plane, or the notes of different birds.

If acute bronchitis pass to the chronic state, the intensity of the inflammation diminishes, but still the signs of auscultation which we have observed during the first period, most frequently continue, and additional ones are observed. In fact, in chronic bronchitis it not unfrequently happens that one of the tubes of the bronchi becomes obliterated. In this case, percussion will give in general the *clear sound*, but on auscultating the region which corresponds to the part of the lungs which receives the ramifications of the obstructed bronchus, the respiratory murmur will not be heard.

The same absence of respiratory murmur is observed in vesicular emphysema; but, independently of the fact that confounding these two morbid states is unattended with dangerous consequences, the duration of the signs, as established by auscultation, will often enable us to distinguish them; notwithstanding which, it occurred

to us once to mistake a bronchial obstruction for emphysema; we were not long, however, in ascertaining our error, when after a few days the respiration was audible in portions of the lung in which it had not before existed. Had it been owing to emphysema, it would not so soon have disappeared.

At other times, the secretion becomes viscid, and completely closes one of the bronchi. If this obstruction occur in one of the first bronchial divisions, its rapid production will produce great difficulty of breathing. The patient assumes the sitting posture if he was reclining, and makes useless efforts to respire. The chest, when percussed, renders the *clear sound*, but the respiratory murmur no longer exists in that portion of the lung which received the branches of the obstructed bronchus.

This instantaneous change in a region which before rendered normal signs, will enable us to distinguish this condition from the preceding. If unfortunately it be not promptly recognised, and the appropriate remedies be not exhibited for its cure, the patient may soon succumb. M. Andral has cited a parallel case in his excellent work, (*Clinique Medicale.*)

One of the most frequent lesions which are encountered, after prolonged chronic catarrhs, is the dilatation of the bronchi. This exists

sometimes throughout the whole extent of the bronchi, while at other times it is more or less circumscribed. In the first case, the air passing through the bronchial tubes, which have a considerable calibre, produces a *puffing sound*, more or less diffused. If in addition, there happen to be liquids in the air passages, their dislodgment by the air which enters and is expelled during each moment of respiration, will give rise to the *mucous rattle with large bubbles*, having much resemblance to the *cavernous rattle*, or gurgling. When the patient who is in this condition speaks, the voice resounds with force through the dilated bronchi, by which *bronchophony* is produced, and sometimes even *pectriloquy*.

Percussion, executed in the direction of the dilated bronchi, will afford a sound more *clear* than in the natural state, and occasionally will render that of a *broken pot*.*

But if the dilatation be only partial, and attack many bronchi at once, percussion will generally render the *flat* or *dull sound*, the effect of the occlusion of the vesicular cavities, compressed by the walls of the dilated bronchi.

From what has been said, it will be seen that

* We have at present under our observation this species of sound, distinguishable at many points of the chest. The multiplicity of these sounds made us doubt the existence of caverns, which opinion was afterwards confirmed by auscultation.

there is much analogy between the acoustic signs which accompany the dilatation of the bronchi and those of a cavern. In fact, we have seen that the dilatation of the bronchi may produce the *puff* sound, called *cavernous*, the *gurgling noise*, and *pectriloquy*, all of which are signs characterizing the existence of a cavern in the lungs.

If, however, these phenomena manifest themselves at many points simultaneously, which happens when the dilatation of the bronchi occupy much space in the lungs, and if, in the progress of the disease, the practitioner observe no rational symptoms of *tubercular pthisis*, such as sweats and colliquitive diarrhœa, the diagnosis will cease to be uncertain. But it will become undoubtedly more difficult, if the bronchial dilatation be circumscribed and confined to a single bronchial tube, which in this case will be similar to a cavern; the only difference existing between them is, that it is formed in one case by the cartilaginous rings of the air passages, and in the other by the parenchyma of the lungs. Percussion in both these instances will afford the *broken pot sound.*

It is therefore only by the presence or absence of rational signs that we can arrive at any clear diagnosis. We will not dissemble the fact that great difficulty may exist, and will avow

that it has more than once happened that partial dilatations of the bronchi, accompanied with copious and fœtid expectoration, have been taken for caverns. If the catarrh continue for a long time, the walls of the bronchi become relaxed, and lose their elasticity. The expectoration takes place incompletely, which facilitates the dilatation of the terminating bronchial ramifications already favoured by the efforts to cough. The vesicles remain almost in a state of stationary dilatation, and in autopsies they are perceptible to the naked eye. This condition of the lungs has been known, since the time of Laennec, by the name of *pulmonary emphysema*.

The air not being able to dilate with advantage the vesicles, and these in turn not contracting during expiration, no *respiratory murmur* is heard.

Percussion will offer a resonance *clearer* than in the natural state, because the quantity of air contained in the air passages is also greater. The continuance of this state causes the lungs to increase very much in volume, and the chest occasionally becomes swollen on that side which corresponds to the emphysema.

If in the course of a chronic bronchitis, which is the point of departure of emphysema, several acute attacks of the same disease intervene, it sometimes happens that the severe paroxysms

of coughing which they occasion, cause the rupture of the pulmonary vesicles, which were already distended almost beyond their capacity. When this happens, the air presses through the newly formed aperture into the interlobular tissue, and elevates the pleura. This passage of the air is accompanied with a particular sound, known since the time of Laennec by the name of *crackling*, or *dry crepitous rattle*, with *large bubbles*. And if the air, thus *extravasated*, raises up the pleura, and forms rounded projections, the friction which these latter produce against the pleura during the movements of inspiration and expiration will produce the *ascending and descending friction sounds*.*

* Acute bronchitis is sometimes confounded with pertussus and pneumonia. From the first of these it may be distinguished by the absence of spasm, and the loud sonorous inspiration which attends pertussus. From the latter, it may be known by the difference in the cough; it being loud and violent in the early stages, and soon becoming loose, with free expectoration. It may also be distinguished by the sonorousness of the chest, and the non-existence of crepitus. Chronic bronchitis sometimes takes on the general symptoms of phtisis, as emaciation, hectic exacerbations, night sweats, cough, and difficult respiration. In these cases, it is by physical examination alone that the true nature of the affection can be determined. The absence of the *flat* sound over the sub-clavicular regions, of pectriloquy and cavernous respiration in chronic bronchitis, and the intermittence of the vesicular murmur in the last affection, will constitute the most material points of difference.—(*Transl.*)

# SECTION II.

## PNEUMONIA.

The term pneumonia is applied to an inflammation of the walls of the pulmonary vesicles; it is sometimes limited to them, and at other times involves the intervesicular cellular tissue. It is one of those affections in which the fewest errors are committed, but which were nevertheless often mistaken until the introduction of auscultation and percussion. It is true that the character of the expectoration is often sufficient to determine the presence of pneumonia. Experience has, however, taught us that in a great number of cases this sign is either entirely wanting, or possesses no quality distinguishing it from bronchitis, and it is only by the aid of auscultation alone, or united to percussion, that we can arrive at absolute certainty.

At the commencement, the rapid congestion which takes place in the vesicles is attended with no other result than the interruption of the secretory process, and the production of a dry and parched condition throughout the whole tract of the inflamed air conduits. In a short time, however, the secretory period arrives, and although in the beginning it does not manifest

itself by any expectoration, auscultation will nevertheless detect the presence of a fluid material in the vesicles.

The mucus, which is at this period secreted, concurs with the air to form, at each inspiration, small bubbles, the rupture of which produces a peculiar sound, similar to that of the ebullition of a fat substance. This sound is denominated the *crepitous rattle*, and constitutes the first sign which auscultation detects in pneumonia.* It is distinguished from the *mucous rattle* without difficulty, inasmuch as it is heard only during inspiration, and has the character of *dryness*. We are of opinion that two varieties of this rattle are to be distinguished, viz.

*First.* The *fine crepitous rattle*, which is analogous to the sound produced by rubbing hair, which is stiff, between the fingers, or to that caused by tearing English taffeta: the presence of this sign may be considered as pathognomonic of pneumonia; indeed, we have never failed in establishing the existence of the affection where we have met unequivocally with this phenomenon. It is possible, however, to confound

* Cases of pneumonia are occasionally met with, which seem to pass so rapidly from the first to the second stage of the disease, that the crepitous rattle is scarcely perceptible, or altogether absent, and nothing can be noticed, on examining the patient, but a diminution of the vesicular murmur, or its obliteration with bronchophony.—(*Transl.*)

it, with the *fine and dry friction sound* which is heard in certain cases of pleurisy, attended with false membranes.

*Second.* The *coarse crepitous rattle*, which greatly resembles the *subcrepitous*. Like the preceding, it is heard only during inspiration; this peculiarity is, however, also common to the *subcrepitous rattle*. This variety is far from establishing the fact of the existence of pneumonia, as is the case with the first of these species; for, without changing its character, it is at one time taken for the *crepitous rattle*, and at another for the *subcrepitous rattle*, according as the other symptoms which accompany it are those of pneumonia or bronchitis.

The *crepitous rattle* is never heard alone throughout the whole extent of the lung inflamed in the first stage. Secretion scarcely ever begins in all the vesicles at one and the same time; while some of them contain bloody serosity, others are entirely permeable by the air. It therefore follows, that the *crepitous rattle* will in the commencement be mixed with the respiratory murmur. If the disease progress, the secretory process becomes established in those vesicles, in which it had not as yet taken place, and the respiratory murmur is superseded by the *crepitous rattle*, which becomes much more extended. If, on the contrary, the disease dimin-

ish in intensity, and the serosity be absorbed, the *crepitous rattle* decreases in extent, afterwards completely disappears, and is finally replaced by the vesicular murmur.

The inflammation has as yet reached only the first stage. The pulmonary parenchyma is infiltrated with fluid, with which the vesicles themselves are but partially filled, and which is susceptible of dislodgement. If an incision be made into the lung, the fluid, mixed with air, passes out, and produces a sound or crepitation analogous to that which is heard in respiration during life.

If, during this degree of inflammation, the lung be compressed with the stethoscope, the same sound will be observed.

Percussion of the chest will render in those points, corresponding to the portions of the lungs which are obstructed, a sound less *clear* than in the normal state. The *flat sound* will not, however, be very marked, in consequence of the fact that a greater or less quantity of air still penetrates the vesicular cavities.

If the inflammation increases in intensity, the pneumonia soon passes to the second stage.

The sero-sanguineous matter is secreted in greater quantity, its viscidity augments, and in a short space of time the pulmonary vesicles are completely obstructed.

The lungs have now a more considerable volume, they no longer return to their original size when the elevation of the anterior portion of the thorax ceases, and their tissue seems to be more firm; the existence of this condition has been characterized by the term hepatization.

This increase of density or firmness is, however, simply an illusion. The pulmonary parenchyma is more friable, as are all other tissues, when inflamed, and take on a true state of *softening*, as has been remarked by M. Andral, one of the most celebrated of our observers.

If the vesicles be uniformly distended by the sero-sanguineous matter which has become viscid and solidified, incisions made into the inflamed lungs would show the surfaces to be united; but if the inflammation do not exist throughout, in the same degree of intensity, if it be only a small number of the vesicular cavities which are obstructed, while the rest are either filled with a small quantity of fluid, or still permeable by the air, it will be found that when the lungs are incised, these collections of air and fluid will escape. The vesicles which contained them will collapse, while those which are distended will present permanent red granulations projecting beyond the level of the incisions.

When the lungs are thus affected, the air no

longer enters into the obstructed vesicles, and the respiratory murmur ceases, its place being supplied by the *bronchial blowing sound*.

The voice will resound with force in the bronchial tubes, which will give rise to *bronchophony*.

On percussing those portions of the chest which correspond to the lungs inflamed in the second degree, the *flat sound, in conjunction with resistance*, will be experienced, analogous to that which is produced, as justly observed by Avenbrugger, on striking a piece of flesh. These signs are unaffected by a change of position, which circumstance establishes the distinction between a pneumonia in the second degree and pleuritic effusion. The remarks which were made in reference to the formation of the *crepitous rattle* apply with equal force to *bronchophony* and the *blowing sound*. In fact, when pneumonia passes from the first to the second stage, it rarely happens that these latter signs are heard throughout the whole inflamed lung; they are in general heard only at certain points, while in some cases the crepitous rattle still continues. In proportion as the disease progresses, the extent of the *crepitous rattle* diminishes, while the *bronchial blowing sound* increases in the same ratio, until at last this latter, with *bronchophony*,

are alone heard throughout the whole extent of the inflamed lung.

When pneumonia has arrived at the second stage, (hepatization, or red softening,) it may take one of two opposite courses; the disease at this period either progresses, and finally passes to the third degree, (hepatization, or grey softening,) or it inclines to resolution, constituting its cure.

The signs of auscultation which are obtained when pneumonia has passed to the third stage, do not differ from those derived from this disease at the second stage. The pathological character of these two states is nearly the same, the only difference being, that in the third stage, the walls of the inflamed vesicles secrete pus instead of sero-sanguineous matter, as in the second.

The pus is generally diffused through the pulmonary parenchyma, so that if the lung be incised in those portions which are inflamed, it will present a grey surface, united together or covered over by granulations.

The formation of abscess is by no means so frequent as was supposed formerly. At the present day, when greater exactness prevails in anatomico-pathological researches, only a few incontestible cases are recorded.

Those appearances which the ancients mistook for abscesses of the lungs, were nothing

more, as has been justly observed by M. Andral, than cavities artificially produced by the accidental breaking down of the pulmonary parenchyma, softened, and filled with pus from the surrounding parts.

If an abscess be formed in the lungs, its presence may be ascertained by the *gurgling*, *blowing*, and other signs indicative of a cavern. Their rapid formation in the course of acute pneumonia will enable us to distinguish them from true caverns, the result of softened tubercles. Gangrene of the lungs may also be recognised by the same signs when it is only circumscribed. The fœtor and other characters drawn from the nature of the expectoration, will enable us to distinguish this termination from a tubercular cavern, or an abscess.

Instead of terminating in one of the states just mentioned, acute pneumonia may pass to a state of chronic induration, a condition which may, however, take place primitively. In this case, the signs of auscultation will not differ from those of an acute pneumonia, except as relates to their progressive course and duration.

If, instead of following this progressive march, the disease, after having arrived at the second stage, inclines to resolution, the *blowing sound*, *bronchophony*, the *flat sound*, and *resistance*, be-

come by degrees extinct, and are replaced by other signs.

It never happens that the lungs pass immediately from the state of red hepatization to a normal condition. This change takes place gradually, by the absorption of a portion of the viscid matter which obstructs the vesicular cavities. In consequence of this absorption, the portion which remains becomes susceptible of dislodgement by the air, so that the *crepitous rattle* is heard anew in the same place in which it had given place to the *bronchial blowing sound*. This reappearance is called the *returning crepitous rattle*. In a short time, all the sero-sanguineous matter is absorbed, there no longer remains any thing to produce the crepitous rattle, and the normal respiration becomes re-established.

These changes do not, however, occur simultaneously in all portions of the lungs. For while in certain points the *blowing sound* has been superseded by the *crepitous rattle*, and this latter again by the normal respiration, in others the *crepitous rattle* scarcely begins to disappear.

It will be perceived, from the facts which we have detailed, that we may, by the aid of auscultation and mediate percussion, recognise and follow the progress of a pneumonia, and that the ear can discover this affection in many cases in which the other signs, as dyspnœa and expec-

toration, would not have led even to a suspicion of its existence. It would be wrong, however, to suppose that auscultation is always an infallible means of diagnosis.

When the inflammation affects a few circumscribed portions in the centre of the lungs, the abnormal sounds, if they exist at all, are masked or concealed by the natural sounds of the surrounding parts. The same will be observed in lobular pneumonia, in which the numerous inflamed lobules are surrounded by others which are healthy.

How often do we experience difficulty in ascertaining, by means of auscultation, a partial inflammation of the base of the lungs! Is it possible to obtain any light on this subject by the aid of percussion? Some authors, and M. Andral in particular, assert that they have observed occasionally either the respiratory murmur to be more marked than ordinary in the partially affected side, or the puerile respiration. The professor whose name we have mentioned above, is of opinion that this circumstance may cast some light upon the diagnosis. Let us however avow, that the case will present great difficulty. How is it possible to distinguish which lung is the seat of the disease, when respiration is heard perfectly, and without *rattles*, in each? Would we not incline to the opinion that

disease was resident in that in which the respiratory murmur was feeblest? Does pneumonia, even when its existence is established beyond all doubt, always follow the same progressive course? Does the *crepitous rattle* always precede the appearance of the *bronchial blowing sound*, and is the latter always followed by the re-appearance of the former before the return to health? If the *bronchial blowing sound* be heard at the commencement of the disease, and with it all the other signs of pneumonia, should the affection be regarded as such, although the *crepitous rattle* has not existed? All these questions are of great importance, and merit a particular and detailed examination. We have already observed, in speaking of the pathology of pneumonia, that inflammation of the pulmonary vesicles has generally for its immediate effect the secretion of a sero-sanguineous fluid, which is capable of giving rise to the *crepitous rattle*. But there exist other cases, in which the pathological condition is not exactly identical. We shall cite two cases, in which the disease at first manifested itself by the *bronchial blowing sound*, which continued during its whole course, and did not disappear until the re-establishment of the normal respiration.

*Case First.*

N***, a mason, aged thirty-two years, entered the hospital of *la Charité* on the twenty-fourth December, 1834. He usually enjoyed excellent health, and had been ill for two days only. Having occasion to leave his bed on the night of the 22d, he rose with no other covering than his shirt, and experienced in consequence a sensation of great coldness. The next day, at noon, he felt uneasiness at a particular point of the right side, and also began to cough; chills succeeded at ten o'clock at night, with the sanguineous expectoration characteristic of pneumonia. The patient had taken a ptisan of dog-grass only.

State on the 25th. Lying on his back, marked dyspnœa, countenance flushed, alteration of the voice considerable, pulsations one hundred. The resonance and respiration were normal at the anterior portion of the thorax. Posteriorly and to the right, a complete *flat sound* at the summit of the lung, and a *bronchial blowing sound* and *bronchophony* in the same region; inferiorly, nothing abnormal; at the left, the respiration and resonance were natural. The *crepitous rattle* could not be detected by the most minute examination; sensation of heat in the chest, expectoration of the color of rust of iron peculiar to

this disease. No evacuation of the bowels since the invasion of the disease. Treatment.—Infusion of marshmallows; venesection 16oz., repeated at night; 12oz. of blood drawn by cups from the region where the distress was felt; a flannel waistcoat to be worn by the patient.

26th. The blood drawn presented a deeply coated appearance, no *bronchial blowing sound* or *crepitous rattle*, normal respiratory murmur heard in those portions in which the presence of the blowing sound had been verified, twenty-two inspirations, pulse sixty-six, alteration of the voice diminished, expectoration less rusty. Treatment —Cataplasm, emollient clysters, white demulcent mixture with extr. lettuce grr. viii.

27th. Eighty-eight pulsations, the other symptoms remaining the same.

28th. Expectoration viscid, mucous, and somewhat yellow; pain at the right side, at first complained of, returned; respiration more rough than natural; no *blowing sound*, or *reverberation* of the voice. Treatment.—Infusion of violets and marshmallows, emollient injections, cataplasm, and diet.

From this period, the patient became rapidly convalescent; no abnormal sound could be heard. He was allowed more nutritious diet, and on the eighth of January was discharged.

The patient, who was the subject of this case,

presented all the symptoms of pneumonia in the second stage—the *flat sound*, with *resistance*, the *bronchial blowing sound*, *bronchophony*, and characteristic rusty expectoration; yet the blowing sound was neither preceded nor followed by the crepitous rattle.

It is true that we have not followed the disease from the time of its first invasion; but if the rattle had existed at its commencement, it would indeed be extraordinary not to observe some *bubbles* at least on the third day. The manner in which the disease terminated, seems to support the opinion which we have given, since we see that the bronchial blowing sound passed immediately to normal respiratory murmur.

What is the cause of this anomaly? To us it appears to depend upon a peculiar disposition of the affected parts. In the ordinary state, the inflamed vesicles secrete copiously a sero-sanguineous fluid, which, when displaced, or agitated by the air, gives rise to the *crepitous rattle*. Subsequently, this fluid becomes solidified, and completely closes the cavities of the vesicles: this causes the air to be stopped in the bronchi, which produces the *bronchial blowing sound*. Was this latter sound, as observed in the case above quoted, produced by the solidification of the secreted liquids? Our opinion is that it was not. The quantity which had been

secreted was too inconsiderable to obstruct the vesicles, and the expectoration was not copious. It seems to us, therefore, that the principal pathological element in this affection was a highly congested state of the air passages, which produced considerable thickening of their walls, so much so, that in the vesicles they touched each other, and thus effaced their cavities.

The alteration of the voice, which is easily explained by the tumefaction of the mucous membrane of the air tubes, is an additional circumstance in favour of the opinion which we have here advocated. The repeated recurrence to venesection unloaded the engorged vessels, the vesicular parietes were relieved from their state of congestion, and, with the alteration of the voice, the blowing sound also disappeared.

*Case Second.*

F. A., a joiner, aged 51 years, entered the hospital of *la Charite* on the 18th of February, 1834. His general health was good until the 7th of the month, when, having the evening before drank a large quantity of cider, which was very cold, he began to experience a sensation of heat in the chest, which was also attended with feebleness, thirst, and cough. He remained confined to his bed, at his own lodgings, until the 18th of the month.

State on the 19th. Lying upon his back; prostration, eyes sunken, cornea covered by nebulæ, appearance of the body resembling that of choleric patients, tongue dry and furred, lips and teeth also without moisture, anorexia, thirst, respiration slow, rendering the movements of the chest scarcely perceptible, no difficulty in breathing, no expectoration.

The percussion of the left side of the chest rendered the *clear sound* throughout its whole extent, while at the right it existed only at the inferior portion. At the superior region of the same side, the sound was flat anteriorly and posteriorly, the respiratory murmur was heard perfectly on both sides, especially where the *clear sound* was observed. At the summit of the right side, the bronchial blowing sound and bronchophony were observed to exist; number of pulsations, sixty-six; inspiration, sixteen; skin neither very hot nor very dry. Treatment.—Infusion of the flowers of marshmallows, white emulsion, with grs. ij of white oxide of ant., laxative enema, diet.

20th. No change, no expectoration. Treatment as above.

21st. Tongue more moist, the sound less flat at the summit of the right lung; the *bronchophony* continues; three evacuations. Treatment as before; three portions of chicken broth.

22d. The sound is scarcely different on either side. The *vesicular murmur* returns at the summit of the right lung posteriorly. Treatment continued, with three cups of chicken broth.

23d. The respiration only slightly *blowing* at the summit of the right lung. Treatment, same prescription.

24th. The pulse preserves its force and suppleness, pulsations sixty; appetite good; respiratory murmur heard more distinctly at the summit of the right lung. Treatment.—White emulsion without ant.; remainder as above.

25th. Mucous expectoration, yellow expectoration, the voice resounded rather more at the right than at the opposite side; prescribed one-eighth of a portion of broth.

On the following day, the respiration approached by degrees to its normal condition; the patient was allowed a larger quantity of food; no trace of the *crepitous* and *mucous rattles* could be observed, and the patient was discharged on the 29th of the month, cured.

It is true, that in the case just cited, we followed the disease from the eleventh day of its invasion only, so that sufficient time had elapsed to allow the pneumonia to pass (according to its ordinary course) to the second degree, and to have been thus circumstanced when it was first examined by us. Judging, however, from the

termination of the disease, which, after having indicated its course by the *blowing sound* and *bronchophony*, passed immediately to the normal state, and did not present any intermediate sounds before the appearance of the respiratory murmur, we are inclined to the opinion, by the force of the evidence before us, that this affection, like the preceding, consisted essentially in a highly congested state of the cavities of the vesicles, and the consecutive obliteration of their cavities.

This pathological condition satisfactorily explains the entire absence of the *returning crepitous rattle*, and affords strong presumptive evidence of the absence of the primitive *crepitous rattle*.

The case which we have just detailed affords a negative proof of the importance of an energetic treatment: the patient had submitted to no treatment previously to his entrance into the hospital; the character of the disease was very severe, although not much extended. At the hospital, he was subjected to a temporizing kind of treatment, in consequence of which we have seen the disease pass slowly to a state of resolution, while in the preceding case, its violence was rapidly destroyed by copious venesection.

These two cases should satisfy us that the presence of the *crepitous rattle* is by no means absolutely necessary to constitute pneumonia,

and that the *bronchial blowing sound* may exist in this affection, without being preceded by the *crepitous rattle.*

At other times, pneumonia manifests itself by its pathognomonic expectoration, by considerable dyspnœa, by marked febrile movement, yet at the same time the ear can neither distinguish the *blowing sound* nor *crepitous rattle*, the respiratory murmur is scarcely to be observed, and a more or less marked *flat* replaces the normal *clear sound.* It will be seen that we have here a variety of pneumonia which corresponds to what was formerly denominated *catarrhal pneumonia*, in which not only the *crepitous rattle*, but also the *bronchial blowing sound*, was wanting.

Shall we speak of those irregular or illegitimate cases, (*peripneumonia notha*,) hypostatic pneumonia, so well described by M. Piorry, in which no other sign of pneumonia is observed but the *flat sound?* These anomalies, far from showing the deficiency of the important discovery of Laennec, have been appreciated and analysed by its means alone; and far from showing the superiority of other signs and methods over it, convicts them of error and imperfection, since they do not take into account those differences which we have been able not only to observe, but also to explain.

## SECTION III.

### PLEURITIS.

By this term is meant an inflammation of the pleura. Sometimes it attacks both the costal and pulmonary pleuræ for a considerable extent, constituting *general pleurisy*. At other times, it is confined to a small portion of the pleura, and is then the *partial pleurisy* of authors.

Partial pleurisy offers three principal varieties; designated under the names of *interlobular*, *diaphragmatic*, and *median*, according to the seat of the disease.

Like inflammation of every serous membrane, pleurisy offers to our consideration alterations of the *pleura itself*, as well as of the fluids secreted by this membrane. If there exist nothing more than a simple congestion of the membrane, or its subjacent tissue, percussion will not seize upon any abnormal character, unless this state continue for several days, in which case, as has been remarked by Corvisart, and as we have recently proved, percussion will detect more or less *flatness*, according to the thickening of the inflamed tissues.

If to the inflammation be added acute pain,

as often happens, the patients expand the affected side less; the air enters in smaller quantity into the lung, and the respiratory murmur is more feebly heard than in the side which is sound. When the inflamed pleura secretes coagulable lymph, it soon becomes concrete, and forms itself into a false membrane, which sometimes covers one of the pleuræ for a more or less considerable extent, or joins, like a bridle, the costal to the pulmonary pleura.

It is demonstrated at the present day, by the experiments of M. Reynaud, that during each inspiration, the pulmonary approaches the costal pleura. If, therefore, the pleuræ be covered with false membranes, these latter rubbing against each other during each movement of respiration, will produce an abnormal sound known under the generic name of "*friction.*"

This sound may have various shades of difference. Sometimes it is so slight that it scarcely deserves the signification of "*grazing noise.*"

In one case, we remember to have noticed that the sound bore a great analogy to the *new-leather sound:* and at the autopsy, it was found that the point corresponding to which this sound had been observed, exhibited a false membrane, which, in its structure, was almost fibrous, uniting the two pleuræ like a bridle.

In another instance it resembled the *sonorous* or rather *the crepitous rattle*. In both these cases, the very superficial origin of the sound, as well as the possibility of hearing the natural respiration in the same point, were the reasons for explaining its presence by the existence of false membranes, which opinion was moreover corroborated by other signs of pleurisy.

When these different sounds are very marked, the hand, if applied to the parietes of the chest, will feel vibrations during the movements of respiration.

When the fluid secreted by the inflamed pleura does not coagulate, and form false membranes, it is effused in the cavity of the pleura, and gravitates to the most dependent part of the thoracic cavity ; so that, if the patient be seated, the fluid descends behind the pillars of the diaphragm close to the vertebral column. Its presence may be recognised by the *flat sound* which percussion renders in this region ; but it is worthy of remark that this *flatness* is never so marked as that of pneumonia in the second stage.

A small quantity may reach a considerable height in the region in consequence of the narrow dimensions of the inferior portion of the pleural cavity ; this circumstance should be taken into account when estimating the quantity

of the fluid. Sometimes the fluid effused will not occupy more than two or three inches in extent, and in this case the diagnosis will demand a particular attention. The *flat sound* of the fluid will be distinguished from that of the liver by the greater resistance of the latter, and by its occupying a position more distant from the vertebral column. The difference between the *flat sound* of the spleen and that of the fluid will not be so marked; but it is sufficient to suspect the presence of effusion, if the *flat sound* be found near the vertebral column on the inner side of the spleen, a region which, in the normal state, renders a *clear sound*, which is owing to a thin elongation of the lung.

If the quantity of fluid be inconsiderable, the parietes of the vesicles being compressed, they approach each other, and their cavities become obliterated. The air no longer enters into the vesicles, and the respiratory murmur is no more heard, but is replaced by the *bronchial blowing sound*.

If, however, the quantity be considerable, and fill nearly the whole cavity of the pleura, neither the vesicular murmur nor the *bronchial blowing sound* will be heard, unless it be near the vertebral column against which the lung is crowded. In proportion as the effusion diminishes, the *bronchial blowing sound* and *ægophony*

return. When, however, the fluid is absorbed, these two signs disappear and are succeeded by those appertaining to the healthy condition.*

In examining with attention patients in whom the hydrothorax is considerable, we have occasionally heard a certain noise which we have denominated the *suction pump sound*. In fact, it closely resembles the gurgling which accompanies the elevation of the piston in this kind of pump, when its body contains only a small quantity of liquid. We have given much attention in order to establish a correct diagnosis between this gurgling sound and that rendered by the intestines, with which it may be confounded. If it be observed in hydrothorax, it will be heard at the superior portion of the chest only, while if it should arise from the abdomen, the contrary will be the case. It also disappears in the former, if the patient be placed upon the abdomen, and returns when he assumes the sitting posture.

In what does the mechanism of this sound consist? And why should it not be met with in all pleuritic effusions? We have not as yet made sufficiently numerous observations in order to resolve these questions, and we content ourselves for the present in drawing the attention of the profession to their consideration.

* Vide Andral, Clinique Medicale, tome 11, Chapter on Pleurisy.

When the effusion occupies only one side of the chest, the opposite side presents either the vesicular expansion in a state of greater development, or puerile respiration.

If a patient affected with pleuritic effusion be made to speak, and if at the same time the hand be applied to that portion of the thoracic parietes which corresponds to the fluid, it will be perceived that the vibrations will either be of a very feeble character, or not exist at all, while in the normal state they are very sensible.

This fact has been observed by M. Raynaud.

If the ear be applied to that portion of the chest which corresponds to the effusion, and the patient be made to speak, the voice will be found to acquire a peculiar irregular reverberation, which bears great analogy to that of Punch, or a goat, whence it has been denominated *ægophony* by Laennec.

We have already given in its place the mechanism of this sound, and have already observed that it depends upon the vibration which the voice produces, in a membrane resulting from the compression and juxtaposition of those vesicles which are most superficial. This membrane vibrates only when thin, and consequently exists only when the fluid is collected in moderate quantity.

The possibility of hearing the *crepitous rattle*

in individuals in whom *ægophony* is present, while at the same time they are affected with pneumonia in the first stage, proves also that the compression extends only to the vesicles which are most superficial.

Laennec attributed this particular reverberation of the voice to its passage across the fluid, and in part to the flattening and approximation of the walls of the bronchi compressed by the fluid and forming species of haunches. But if this opinion be true, *ægophony* should still continue when the effusion is considerable. This author further remarks, that he has produced an analogous modification by applying bladders filled with water over the chests of many patients.

It does not happen in all cases that *ægophony* is so marked that it can be easily distinguished from *bronchophony*. On the other hand, some persons, though in the enjoyment of excellent health, have the voice so irregular that it is liable to be mistaken. Whence it follows that in many cases *ægophony* should be considered merely an auxiliary sign.

The want of the vibrations of the chest during the emission of the voice in those parts corresponding to the effusion, is not much more sensible where the quantity of the fluid is inconsiderable.

The *bronchial blowing sound* and the *flat sound*,

which are characteristic of ordinary effusion, may be observed equally in pneumonia in the second and third stages.

But notwithstanding this approximation, these latter two signs are not equivocal. In fact, if a patient in whom the *flat sound* and the *bronchial blowing sound* have been verified posteriorly in the sitting posture, be made to lie upon the abdomen, the fluid will gravitate to the anterior part of the chest, now become the most dependent.

They will both disappear behind, and be replaced either by the signs of the normal state, or by rattles, provided the bronchi or the pulmonary parenchyma are affected at the same time that the pleuritic effusion exists.

If the patient be drawn in this position to the edge of the bed, and the anterior part of the chest, now become the most dependent, be percussed, that portion which in the vertical position rendered throughout its greatest extent, the *clear pulmonal sound*, will now produce the *flat sound*, arising from the presence of the fluid.

These two explanations of the anterior and posterior portions of the chest, alternately and frequently repeated, will leave little or no doubt in reference to the nature of this morbid state.

When the patient is placed upon the abdomen, care must be taken not to mistake the flat

sound of the heart, which in this position extends considerably over the chest, for that of the displaced fluid. This remark is due to M. Piorry.

The displacement of the fluid will, however, not take place if the effusion be very great. If one side of the chest be entirely filled with fluid, it will not change place, whatever may be the position assumed by the patient. However, the progress of the disease, joined to the absence of the respiratory sound, and the vibrations of the voice, as well as the existence of certain rational symptoms, will throw much light upon the diagnosis, and will enable the practitioner to distinguish between pleuritic effusion and a chronic engorgement of the lungs, with which it may be confounded.

There exist many other circumstances which may increase the difficulty of the diagnosis of hydrothorax. If the false membranes retain on all sides the effused fluid, the latter cannot be affected by a change of position: in this case, the *blowing sound* and *flatness*, signs which are common to effusion and hepatization of the lungs, will lose their distinctive character, and will involve the case in doubt, or rather their immobility will lead to the supposition that it was hepatization.

It may also happen that the fluid is retained

in the anterior portion of the thorax. In this case, the lung is not crowded inwards towards the vertebral column, but directly towards the posterior part of the chest; if this exist, the signs of this affection will be no longer found as before in the posterior, but in the anterior part of the thorax, since the former will offer normal indications.

How often do we not experience difficulty in the diagnosis, when the fluid is retained by false membranes at the top of the lung, which is the usual seat of chronic engorgements?

It occasionally happens that the *flat sound* of pleuritic effusion continues in the interior part of the chest, and extends quite to the præcordial region. Does the *flat sound* of this latter region depend upon the fluid effused into the pleura, or upon that collected in the pericardium? This question is frequently presented to us in practice. It would in general be more easily resolved, if the practitioner reflected, that in order for the liquid contained in the pleuritic cavity, to extend in front of the heart it must rise posteriorly nearly as far as the spine of the shoulder blade. Convinced of this fact, whenever we find an abnormal *flatness of sound* in the præcordial region, to become confounded with that of a pleuritic effusion, which does not rise above the middle of the chest, we should attribute the *flat*

*sound*, rendered by the heart, to pericarditis with effusion, complicating pleurisy.

There exists, however, another circumstance which may elucidate this question. I allude to those sounds of the heart which are never so *flat* and *distant* in the case of pleuritic effusion as in pericarditis. In fact, a pleuritic effusion scarcely ever completely covers the heart; it rather pushes it beneath the sternum, where its superficial sounds may be heard.

It will nevertheless be frequently doubtful whether the *flat sound* observed in the præcordial region be merely owing to pericarditis or to an effusion in the mediastinum.

Anterior to the period at which, it was ascertained that pericarditis had signs appreciable by auscultation, this distinction was impossible; even at the present day, it still offers much difficulty in many cases.

If, in addition to the *flat sound*, the natural sounds of the heart be distinctly and superficially heard, we may be certain that the effused fluid is contained in the mediastinum.

But if the effusion in the mediastinum be more considerable, if it compress and remove more deeply the centre of the circulation, the *flat* and *distant sounds* of the heart might lead the examiner to suspect the existence of an effusion in the cavity of the pericardium.

It will be still more easy to commit this error, if, during the movements of the heart, some abnormal sounds be heard, a circumstance which may easily occur, if in consequence of the compression of this organ by effusion in the mediastinum, its orifices become contracted.* Finally, is it ever possible to recognise the existence of effusion, when the result of an inflammation of the interlobular pleura? In this instance, the fluid is contained in a sac, the parietes of which are formed above and below by the inflamed interlobular pleuræ, and completed by the false membranes thickened and stretched from one lobe to the other.

These cases have been encountered in practice, and M. Andral has cited an exceedingly curious example in his clinical work.

If there be serosity and gas in the cavity of the inflamed pleura, the gas will occupy the upper part, and its presence may be recognised by the increased clearness of sound; the lower part being occupied by liquid. By shaking the patient, the noise of the fluid as it fluctuates, will be perceptible to the ear, a phenomenon observed by Hippocrates.

* Vide Article Péricardite, published by M. Bouillaud, in the Dictionnaire de Médécine, in fifteen volumes.

## SECTION IV.

### TUBERCLES.

This term, formerly so vague, has at the present day a more precise signification. By it is meant a morbid production generally of a rounded form, of a yellowish white appearance, of various size; solid, but friable when first formed, finally softening, and transformed into a heterogeneous mass, which soon leaves the pulmonary parenchyma, and at last, being eliminated by expectoration, leave no other traces in the organ except an empty cavern which they formerly filled.

If the tubercles be still small and few in number, they will offer no particular sign which can be detected by percussion and auscultation, unless they be complicated with some other affection, as for example, chronic pneumonia, which may be primitive and give rise to tubercles, or secondary, and be the product of irritation, excited by these morbid formations.

These small bodies do not compress the walls of the vesicles so extensively, as to prevent the introduction of a due quantity of air, and thus give rise to the *bronchial blowing sound*, the *flat sound*, or *bronchophony*. It is only when the tubercles acquire considerable volume, and form large

masses, that percussion and auscultation can lead us to suspect their presence, by detecting the existence of the three signs indicated above. This latent march of tubercles is not, however, the course which they usually take.

They in general begin to show themselves under the form of bronchitis or chronic pneumonia; if the former give rise to them, the inflammation of the bronchi, either in consequence of the negligence of the patients or by an opinionated resistance to treatment, is propagated to the terminating bronchial ramifications and to the vesicles, producing chronic engorgement of the lungs, or chronic pulmonary hepatization.*

* Dr. Latham divides phthisis into two species, the *mixed* and *unmixed*. The former is in general complicated with pneumonia, and presents the auscultory signs which are peculiar to the two diseases in question—besides dulness beneath the clavicles, pectriloquy, and cavernous respiration, there is also crepitation over a large portion of the chest, showing extensive inflammation of the lung. Of the unmixed species, there are two varieties. In the first, the tubercles, although largely deposited, remain for a long time in a crude state, and give rise only to the more obscure symptoms of phthisis, as diminution of the vesicular murmur, the flat sound on percussion, slight emaciation, dry cough, &c. until the period of softening arrives, when the patient sinks rapidly. In the last variety, the tubercles form slowly, and excite around them just sufficient inflammation for them to be eliminated, after which the patient returns to a state of comparative health, until a new deposite develops again all the pathognomonic symptoms of the disease. Persons thus affected may contend for a long period against the malady, and by judicious treatment may be enabled to perform many of the active duties of life.—(*Transl.*)

These morbid phenomena may also take an inverse course; thus the disease may commence in the pulmonary parenchyma, and the inflammation be only consecutive.

When the affection begins by chronic pulmonary hepatization, it manifests itself by the signs of pneumonia in the second or third stages.

The acute or chronic march of the disease is then the only difference between pneumonia and tubercles.

Whenever these symptoms remain during a long time, and if in addition, the patient present all the peculiarities of a predisposition to tubercles, it may be presumed that these adventitious products are formed. If tubercles be developed in one lung, the respiration of that of the other side generally presents the *puerile character*.

Tubercles do not, however, remain always in the same state. Their presence keeps up a focus of irritation in the pulmonary parenchyma, and in the case of females at the menstrual period, the blood instead of being directed towards the uterus flows to the lungs. In both sexes persons of plethoric habit are affected with considerable congestion of the lungs, and it is in these organs that are experienced the primary effects which are produced by every derangement in the circulating centre.

These congestions exert a dangerous influ-

ence upon the course of the tubercles. The chronic inflammation of the pulmonary parenchyma takes on an acute character, which greatly facilitates the softening of these morbid formations.

When the tubercular masses once become softened, the phenomena presented by auscultation begin to change entirely their aspect.

If the softened matter be contained in the air passages, they are susceptible of dislodgement, and different *rattles* may be heard during inspiration, such as the *mucous*, *subcrepitous*, and occasionally even the true *crepitous*.

The same result will take place when the tubercles occupy the intervesicular cellular tissue. In fact, the suppuration very soon destroys the walls of the air tubes, and causes them to communicate with the centre of the tubercular mass.

The excavations are not, however, as yet so large as to render the *cavernous sound* perceptible. And as at this period of the affection, pulmonary engorgement constitutes the essential element of the lesion, it most frequently happens that *flatness* of sound is observed all around those regions where the above-mentioned rattles are heard.

When the destruction of the lungs continues, new excavations of greater extent are formed

which manifest themselves by new signs. If the cavern be filled with a *muco-purulent fluid* secreted by the inflamed sides, the dislodgement or agitation of this matter during the passage of the air, will produce the *gurgling noise* or the *cavernous rattle.*

If the matter be completely expectorated, this deep gurgling noise will not be heard; but the air passing through the cavern will resound with greater power, and will give rise to the *cavernous blowing sound*, or the *cavernous respiration.*

The resonance of the voice will be very great at the point corresponding to the cavern, and will appear to the explorer as though it were transmitted directly to the ear. This latter phenomenon has been known since the time of Laennec by the appellation of *pectriloquy*.* It is always better observed with the stethoscope than with the naked ear, arising perhaps from the circumstance that the diameter of the instrument not exceeding that of the cavern, the normal vibrations of the voice reach the ear solely, and are neither confounded nor enfeebled by the resonance of the voice in the surrounding regions.

* A perfect idea may be obtained of this sound by placing the stethoscope over the trachea of a person, and at the same time desiring him to speak. In phthisis, pectriloquy becomes very distinct, if a portion of indurated lung intervene between a cavern and the parietes of the chest.—(*Transl.*)

It is true that the two latter signs, the *cavernous blowing sound* and *pectriloquy*, are pathognomonic of a pulmonary cavern; a single engorgement of the lungs, with considerable induration of their parenchyma, may however produce the *bronchial blowing sound*, as well as *bronchophony*, of so marked a character, that they resemble perfectly the two phenomena first mentioned.

Lastly, a case was once presented to us in which many practitioners believed they had detected the existence of a cavern. On exploring the chest, we were also of opinion that we heard the *cavernous blowing sound* and *pectriloquy*. However, the absence of a sound like that of a *cracked vessel*, and the existence of great *flatness* at the summit of the lungs, induced us to suspect the existence of chronic induration, and that the *cavernous blowing sound* and *pectriloquy*, supposed to be observed, were nothing more than the *bronchial blowing sound* and *bronchophony* of a more marked character than ordinary. The two former were soon replaced by the *mucous rattle*, resulting from the softened tubercles, which confirmed still more strongly the truth of our position.

If the region corresponding to the empty cavern be percussed, while the patient keeps the mouth open, a particular sound will be heard,

which is similar to that produced by a cracked vessel.*

The signs which we have just enumerated are not to be considered as being invariable, since they change from time to time. It is thus that the same part of the lung which shortly before offered the *cavernous rattle*, will, after free expectoration, render the *cavernous blowing sound* and *pectriloquy*, and will yield, on percussion, the *broken pot sound.*

In case the cavern is large, and occupies nearly the whole of the lobe, auscultation will enable us to detect "*amphoric respiration.*" If the cavern contain a certain quantity of liquid, a tinkling analogous to that of a small bell just after being rung, or a noise similar to that produced by a fly buzzing in a vase, will be noticed. This is the *metallic tinkling* of Laennec.

These last two sounds will be observed still more distinctly if the cavern break into the pleuritic cavity. Percussion will enable us to distinguish the quantity of gas and liquid contained within the cavity.

* It may also happen that this sound does not correspond to a true cavern, but to a partial dilatation of the bronchi. We have already shown the manner in which the diagnosis may be established, in the Chapter on Bronchitis (8.)

## SECTION V.

### HÆMOPTYSIS.

Blood discharged from the mouth may proceed from different sources, but the term hæmoptysis, has been restricted to the spitting or expectoration of blood, caused by hæmorrhagic exhalation from the mucous membrane of the bronchi and pulmonary vesicles.

The blood being exhaled into the bronchi is subject to dislodgement during the passage of the air, and produces the *mucous rattle*. If the seat of the hæmorrhage be in the pulmonary vesicles, or if the blood exhaled into the bronchi gravitates into the former, it is generally there transformed into solid clots which obstruct their cavities and prevent the entrance of air.

To this latter form of hæmorrhage of the air passages, Laennec has given the name of *pulmonary apoplexy*.

It will be anticipated from what we have said in the early part of the work, that the *flat sound* will be produced in that portion of the chest corresponding to the *apoplectic engorgement*. The ear will also seize upon the *bronchial blowing sound* and a slight *resonance of the voice*, surround-

ing which, will be observed the *mucous rattle*, proceeding from the agitation or dislodgement of the liquid blood contained in the neighbouring bronchi.

## SECOND ARTICLE.

## AFFECTIONS OF THE CIRCULATORY ORGANS.

## SECTION I.

### PERICARDITIS.

By this term is meant an inflammation of the pericardium. The ancients were unable to recognise the existence of this affection except at autopsical examinations, and its diagnosis should be regarded as the acquisition of our century.

So skilful an observer as Laennec declares that he himself could never distinguish the signs of this affection during life, and that if at times he conjectured its existence, it was rather by guessing than by an inference drawn from definite signs.

M. Louis has recently investigated this heretofore obscure subject, and has removed in a great measure the mystery which invested it.

The signs which this excellent observer considers pathognomonic of pericarditis are not, however, always indicative of its presence. It

has been only during a few years past that M. Bouillaud in France, and Latham, Hope, and Stokes in England, have observed certain unering signs distinguishable by the two methods to the improvement of which, we have devoted this work.

It is not our present intention to discuss the merit of priority in regard to the labours of these physicians. We shall content ourselves at present with asserting, that we have seen the diagnosis of pericarditis established by M. Bouillaud, by means of percussion and auscultation, before this celebrated practitioner had become in the least acquainted with the observations of the English physicians.

Pericarditis presents, as respects its pathological condition, many points of interest. The traces of inflammation are often apparent in the redness of the parts in which it was seated. The inflammatory action is variously distributed. Sometimes it is marked by small red points, at other times by a plane surface, or by arborisations.

The last of these may be seated in the subserous cellular tissue, as frequently happens, or in the serous expansion itself.

It rarely happens that the pericardium becomes thickened in consequence of inflammation: this result has, however, been known to exist.

The normal function of the pericardium, viz. the secretion of serum, is subject to variations which affect the quantity and quality of the fluid. The quantity from two or three spoonfuls, may be increased to a large volume, capable of producing the distension of the pericardial sac.

The nature of the liquid is subject to many changes, occasionally it is limpid or a yellowish lemon colour, sometimes it is bloody. At other times it is divided into two portions, one aqueous, and the other thicker, which coagulates, and becomes deposited on the walls of the serous sac in the membranous form.

The false or adventitious membranes which it forms are of different species: sometimes they are deposited in the form of bridles, which unite the parietal to the cardiac portion: at other times they cover the serous expansion of the pericardium more or less extensively. Though if this be the case, they have a peculiar appearance, which is met with in no other inflammation of serous membranes. Far from being united, like the false membranes of other serous tissues, they present unequal surfaces, and are thickly set with numerous elevations, separated from each other by depressions. These inequalities are occasionally so regular that they present real concave indentures, which, receiving the conical

form of the heart, have a considerable resemblance to a pine-apple.

At other times, the internal surface of the pericardium resembles, according to the just comparison of Corvisart, a fillet of veal or a honey-cake.

It has been compared by Hope to the surface which is produced by separating two plates besmeared with butter. M. Bouillaud has compared its inequalities to those which are observed on a cat's tongue.

What is the cause of this peculiarity in the form of the false membranes of the pericardium, and why are not these inequalities presented in those of other tissues? Does not the resemblance which Hope has established, between the appearance of these membranes, and the surface obtained by separating two plates besmeared with a fatty substance indicate, as M. Bouillaud has observed, that it is caused by the increased action of the heart?

Sometimes these false membranes entirely disappear by resolution: at other times, the liquid parts only are re-absorbed, while the more dense portion remains attached to the pericardium, or forms *milky expansions;* again, this plastic material may form excrescences, become cartilage, or ossify.

In case the pericardium does not contain any

fluid, the *flat sound* of the heart will be noticed to be nearly in the normal state, unless the heart increase in volume in consequence of congestion produced by the excitation of the organ which envelopes it. In this case, the *flat sound* of the heart will extend itself rapidly, and valvular sounds will be heard *distinctly* and superficially.

This augmentation of volume may be the result of inflammation of the internal portion of the heart; and it will be occasionally difficult to distinguish this latter affection from pericarditis, attended with the same complication. Happily, the error would not lead to dangerous consequences, because these two morbid states require nearly the same treatment.

If the pericardium contain serum, the *flat sound* will be proportioned to the quantity of the fluid effused; its rapid appearance will enable us to distinguish it from the *flat sound* significant of hypertrophy of this organ.

If, after having examined the præcordial region while the patient is reclining upon his back, the superior and inferior limits of the fluid be marked, and if afterwards the patient assume the sitting posture, it will be found that the boundaries will be more or less below the preceding points, which proves that the *flat sound* no longer de-

pends upon a simple augmentation of the volume of the heart resulting from congestion.

Could the same conclusion be drawn if the lateral limits of the fluids were changed, when the patient leaves the dorsal position and lies upon one side? We think not, because the change might depend upon a difference of position in the heart itself.

Auscultation has discovered, at the present day, many signs by which the presence of pericarditis may be detected.

When the pericardial sac is the seat of an effusion which is more or less considerable, besides the flatness which is produced by percussion, auscultation will discover the obscure and distant sounds of the heart, though the ear will not perceive the impulsion of the organ. To these characters may be occasionally added the *blowing sound*, resulting from the compression of the heart and its orifices by the pericardial effusion. If, instead of containing a fluid, the sac be covered with false membranes, the heart coming in contact with their irregularities during each systole, will produce successively the *grazing*, *friction*, *blowing*, *saw*, *rasp*, and *new leather sounds*, all of them caused by the same mechanism, and presenting only different grades of friction.

Of these, the *new leather sound*, first noticed

by M. Collin, and which we have once had an opportunity to verify, is almost peculiar to pericarditis. Sounds analogous to all the others of the inflamed pericardium, are also to be heard in different lesions of the heart.

However, whenever these sounds are superficial, and seem to pass immediately to the ear, and principally during the approximation of the point of the organ, the strong presumption is that they are produced in the pericardial sac, and that an inflamed state of it constitutes the affection.

Another distinctive character peculiar to the sounds which this disease gives rise to, is the extent of their resonance; those produced from a lesion of the valves, or orifices of the organ, are heard over a considerable extent, whereas those which proceed from the pericardium are confined to the præcordial region, and permit the valvular sounds to be heard below the left clavicle.

If the affection be acute, and if the abnormal sounds, instead of being superficial, are quite profound; if they be heard more distinctly over the orifices of the heart than elsewhere, it is very probable that they are owing to inflammation of the interior of the organ, which may give rise to different affections of the valves and orifices, the

existence of which would easily explain the formation of these abnormal signs.

There still exist some other symptoms which may throw some additional light upon the diagnosis.

Thus, if after having heard the *blowing sound* when the patient was lying on the back or in an upright position, it is found to disappear when the patient is placed on the right side, it would be strong presumptive evidence that false membranes existed in the pericardial sac, and that the *blowing sound*, which depended upon the friction of these false membranes, when the point of the heart approached the parietes of the chest, has disappeared, because in the present position it is farther removed from them.*

## SECTION II.

### AFFECTIONS OF THE HEART.

After having, in the early part of the work, passed in review those signs of percussion and

* The close connection existing between articular rheumatism and pericarditis, from the similarity of the tissues entering into the composition of the parts affected, has of late created much attention in relation to the latter disease. For particular information in relation to this subject, the reader is referred to the work of M. Bouillaud, lately published in Paris.—(*Transl.*)

auscultation which are offered to our consideration by the centre of the circulation, both in health and disease, and having indicated the organic lesions with which they correspond, in order to explain their mechanism, it only remains for us to follow each disease in its course, and to assign to each of its stages and phases, the corresponding modifications of its primitive signs, as we have already done when treating of the other organs.

On one hand, among the various phenomena which we have specified under the names of *blowing*, *bellows*, *saw*, and *rasp sounds*, &c. the same sign does not always belong to the same affection, and on the other hand many diseases of the heart have nearly the same course, and do not offer much difference in the physical signs which accompany them.

For example, we have remarked, and not without consideration, that hypertrophy, accompanied with dilatation of the ventricles, produces greater *flatness of sound* in the præcordial region, and increases the shock of the heart. Is it necessary, therefore, to devote a chapter especially to this subject, to say that these signs will diminish in force and extent in proportion as the heart returns to its normal condition?

Thus, instead of following the disease step by step, and describing all the signs successively,

the question which we ought to resolve is this: an abnormal sound being observed, to determine by the signs peculiar to it, and by other circumstances which accompany it, to what lesion it corresponds: whether it be the effect of a contraction of the orifices of the heart, of an injury of the valves, the dilatation of the orifices and reflux of the blood from the ventricles into the auricles, or lastly, whether it depend upon any lesion whatsoever which we have described among the causes of the *bellows sounds?*

The solution of these questions is attended with great difficulty. In general, the better way of proceeding is by the method of exclusion. We recently saw a young female, aged twenty years, presenting a chlorotic constitution and a complexion of wax peculiar to these cases. This patient experienced frequent palpitations of the heart, suffocation, and for some time past, œdema of the ankles occurring towards night. The exploration of the heart presented flatness in a greater degree than in the healthy state, the *blowing sound* was also distinctly heard during the contractions of the ventricles. To what kind of disease were the symptoms owing? Was it chlorosis, or an organic lesion of the orifices of the valves?

The attendant physician had embraced the latter opinion, which at first sight appeared to us

to be undoubtedly the case. The patient, however, was subsequently examined by M. Bouillaud, who determined the affection to be chlorosis. In fact, even though it were true that the symptoms observed were proper to lesions of the valves or orifices of the heart, the accompanying circumstances of age and constitution would refute such an opinion.

Again, it is probable that in chlorosis, the heart partakes of the nature of the muscles of animal life, that it becomes attenuated, and readily yields to the efforts of the blood tending to dilate it. The auriculo-ventricular orifices will participate in this dilatation, and the blood flowing back from the ventricles into the auricles in virtue of this disposition, will easily give rise to the *blowing sound*.

The œdema of the ankles is a characteristic sign of an obstructed circulation; thus, in chlorotic patients, in whom the blood contains much serum, which is discharged from the vessels under different forms, (œdema of all the tissues, fluor albus, &c.) we should not be astonished that this serous effusion becomes at times more considerable, and gravitates by its weight to the ankles. Besides, the patient had never experienced pain in the præcordial region; the movements of the heart were very superficial, the abnormal sounds were most distinctly heard

at the base of the heart, so that the presence of pericarditis could not be suspected either as complicated with effusion or false membranes.

The constitution of the patient led to the opinion that the blood was poor in fibrin, so that the supposition that the disease was occasioned by the presence of clots could not be maintained, and was still farther exploded by the progress of the affection.

It will be seen that it was only by the method of exclusion that a correct diagnosis was formed, and the truth of the existence of chlorosis established; in consequence of which, tonics were prescribed, and at the end of one month after this treatment had been enjoined, (the period at which the observation was made,) the *blowing sound* had nearly ceased.

If, however, the patient who presents this character of sound be robust, and if he has previously had articular rheumatism, or has experienced pain in the præcordial region, or much suffocation, or if the limb be œdematous, there would be strong grounds to believe in the existence of a lesion of the valves of the heart, accompanied with contraction of the orifices. Still greater certainty would be attached to this supposition, if instead of the *blowing* the *rasp sound* were heard.

Finally, hypertrophy of the heart, with dilata-

tion of the ventricles, but without valvular lesion, may be recognised, when powerful movements of the organ, dullness of greater extent, an valvular sounds of greater obscurity than natural, exist without being accompanied with dropsy, or much dyspnœa, and when the body is rather red than livid.

Organic affections of the heart often give rise consecutively, to a collection of serum in the pulmonary vesicles, (œdema of the lungs,) to effusions in different cavities, to enlargements of the liver, &c. We have already pointed out in the chapters treating upon this subject, the means of diagnosis between these last complications.

The fluid which constitutes œdema of the lungs will be agitated during each inspiration, and will consequently produce the *subcrepitous rattle.**

* In ausculting the heart, the patient should be directed to hold his breath for a short time, as the respiratory sounds frequently render it difficult for the practitioner who is inexperienced in this method of examination, to seize upon those which belong to the heart.—(*Transl.*)

# SECTION III.

## ANEURISM OF THE AORTA.

Anterior to the time of Corvisart, great uncertainty prevailed in reference to aneurisms of the aorta.

Although this physician has made many profound researches upon this subject, yet he himself declares the diagnosis of aneurism of the aorta to be liable to great obscurity, if it be not evident externally, and that it could not be known unless the tumour projected; both of these assertions are false, since it may occasionally happen, that a tumour of an adventitious formation may elevate the ribs, and receive the pulsations of the subjacent aorta.

The majority of the signs given by Corvisart as pathognomonic of this disease, such as the hissing voice, the obscurity of the sound in the superior and middle portions of the sternum, the smallness and irregularity of the pulse, and its inequality in the two arms, may all proceed from different tumours when they compress either the bronchi or the arterial trunks.

The rustling noise perceptible by the hand above the tumour, does not always exist in

organic affections of the circulatory centre. Laennec also avows that the diagnosis of aneurisms of the aorta is often exceedingly difficult; he however was enabled occasionally to detect their existence by means of the simple pulsations heard in the direction of the aorta.

The observations of M. Bouillaud have since added greater importance to this sign, which he considers a sure characteristic of aneurism. According to him, "if the disease occupy the sternal aorta, the pulsations may be heard under the sternum and beneath the cartilages, varying in extent according to the volume of the tumour. The simple beating will become evident in proportion as the tumour increases in volume, and is situated in reference to parts that vibrate."

Aneurisms of the descending pectoral aorta, especially those which cause absorption of the vertebral column, will manifest their presence by the simple pulsations corresponding to the diseased vertebræ, a sign which is rendered the more certain, as remarked by Laennec, inasmuch as the double contractions of the heart are rarely heard in the back.

It is true that one might be induced to take the pulsations heard above the sternum, for the reverberation of the first sound of the heart; but it should be remembered that the former greatly exceeds the latter in intensity, so much so that

as observed by M. Bouillaud, it is occasionally disagreeable to the ear.

The pulsations of an aneurism of the abdominal aorta, may be distinguished from those which are characteristic of inflammation or spasm of this vessel, by the extent of the impulsion, and by the power of the sound, which is of a more marked character in the former than in the latter of these affections.

If percussion produce the *flat sound* over a considerable portion of the region corresponding to the simple pulsations, it would be a sign confirmatory of the truth of the diagnosis drawn from auscultation; though, if considered without reference to this connection, it would in no case lead to any positive result.

FINIS.

# A SYNOPTICAL TABLE

## *Of the Signs of Auscultation and Percussion, applied to the Diagnosis of Diseases.*

| CONDITIONS OF THE ORGANS. | MECHANISM OF THE FORMATION OF THE SOUNDS. | SOUNDS OF THE ORGANS WHEN PERCUSSED. | SOUNDS OBSERVED BY AUSCULTATION. | DISEASES IN WHICH THESE SOUNDS OCCUR. | OBSERVATIONS. |
|---|---|---|---|---|---|
| Normal state; permeability of the air-cells. | Expansion and contraction of the air-cells principal cause of the natural respiratory murmur. | Clear. | The vesicular murmur. | Normal condition. | The respiratory murmur i[illegible] portions of the thorax. [illegible] sound towards the root of the [illegible] liver, as well as in that of the [illegible] the whole of this latter organ, as is the case [illegible] |
| Lungs sound, powerful respiration in children; contraction in the adult of the vesicular cavities in one of the lungs, or in a portion of it only; the other parts remaining healthy. | Expansion and very considerable permeability of the air-cells in the portions which are sound. | Very clear. | Puerile respiration. | Natural state in children; morbid in adults. Pneumonia in the second or third stage; tubercles; pleurisy, with effusion. | Puerile respiration will be heard on the side affected, in those air-cells which surround the [illegible] The same will be observed [illegible] confined to a limited porti[illegible] the [illegible] |
| Relaxation of the parietes, and dilatation of the pulmonary air-cells, after a catarrh of long standing, with obstruction of several of the bronchi and the presence of a greater quantity of air than is natural. | Deficiency of vesicular expansion and contraction. | Very clear, almost tympanitic. | Absence of the respiratory murmur. | Vesicular emphysema. | A circumstance pecu[illegible] lar murmur is not [illegible] |
| State similar to the preceding. And in addition rupture of the air-cells. | Passage of the air into the inter-vesicular cellular tissue. | Idem. | Crackling or dry crepitous rattle, with large bubbles. | Emphysema, with rupture of the air-cells. | |
| Complete dilatation of one or more of the bronchi. | Passage of the air through the dilated bronchi. | Clear; sometimes sound of a cracked pot. | Diffused bronchial blowing sound | Bronchitis. | |
| Circumscribed dilitation of one of the bronchi resembling a cavern; or a true cavern existing in the pulmonary tissue. | Passage of the air through the cavern. | Sound of a cracked pot. | Cavernous respiration or blowing sound. | Bronchitis. Tubercles with a cavern. | The sound similar to that of a cracked vessel is not heard, unless the cavern be empty and communicate with the external air. It is often difficult to distinguish by [illegible] ion, a true cavern from a partial [illegible] of the [illegible], The examination, however, of other accompanying [illegible] and sweats, and the antecedent circumstance [illegible] the [illegible] agnosis clear. |
| Considerable excavation in the lungs, or communication of the pulmonary parenchyma with the pleural cavity. | Passage of the air into a vast cavern, or into the cavity of the pleura. | Tympanitic sound, or that of a cracked pot. | Amphoric respiration. | Tubercles. | |
| Obstruction or obliteration of air-cells. | Greater friction than natural of the air against the parietes of the bronchi. | Flat or dull sound. | Bronchial puff or blowing sound. | Pneumonia in the second or third stage. Pulmonary apoplexy of Laennec. Tubercles, with induration of the lungs. Pleuritic effusion. | The bronchial blowing sound is observed to exist, to a considerable extent, in pneumonia in the second and third stages, and does not change its position, whatever may be that assumed by the patient. The same is true of tubercles accompanied with induration of the lungs. In the pulmonary apoplexy of Laennec, the extent of this sound is very small, and surrounding the apoplectic engorgement is heard the mucous rattle caused by the agitation of the liquid blood by the air. In pleuritic effusion, this sound may change its place simultaneously with [illegible] |
| Inequalities of the surface of the pleura sometimes caused by excavations of the pleura covering the lung, raised up by the air, at other times, it is owing to the presence of false membranes. | Friction of the rough surfaces of the pleura. | Sound peculiar to the diseases in which these inequalities are observed. | Ascending and descending friction sounds. | Emphysema. Pleurisy, with false membranes. | The [illegible] by [illegible] that of new leather, or of parchment when rubbed [illegible] |
| [illegible] of a bronchus at a particular point, produced sometimes by the tumefaction of the mucous membrane alone; at other times, by viscid or ropy mucus. | Vibrations excited in the edges of the contraction during the passage of air. | Normal, or somewhat less clear than natural. | Dry or grave sonorous rattle, or sonorous [illegible] Bronchus | Bronchitis. | The [illegible] [illegible] |
| Greater degree of contraction of a bronchus. | Passage of the air through the portion contracted. | Idem. | Bronchial rattle, either dry or sibilant. | Bronchitis. | The rattle may also disappear after expectoration. Its union with the preceding, and with the mucous rattle, often produces sounds analogous to the cooing of turtle doves or the cries of different birds. |
| Complete obstruction of a bronchus, sometimes produced by the tumefaction of the mucous membrane alone, or together with the adjacent tissues; at other times by viscid expectoration. | The air prevented from entering into the air cells by an obstruction existing in the bronchi. | Clear. | Absence of the respiratory murmur in all the parts of the lung, which receive the ramifications of the obstructed bronchus. | Bronchitis. | In the case of bronchial obstruction from the tumefaction of the mucous membrane, the disappearance of the respiratory murmur is slow and gradual; but if it be [illegible] viscid mucus or matter, directly the reverse is observed. |
| Presence of fluids in the trachea. | Agitation or dislodgement of the fluids by the air. Formation of large bubbles. | The sound given by the lungs is more or less flat. | Tracheal rattle | Period immediately preceding death. | As in the majority of those cases of approaching dissolution in which this rattle is heard, the lungs are more or less engorged, the sound obtained by percussion will almost always be proportionately obscure, approaching the flat or dull sound. |
| Presence of fluid, as in pulmonary excavation. | Idem. | Flat or dull if the excavation be completely filled with fluid, or humoric if it contain liquid mixed with air. | Cavernous rattle. G[illegible] rattle. | Cavern from tubercular softening. Partial dilatation of a bronchus. | The rumbling or gurgling noise may be heard in the case of a cavern arising from tubercular softening, and also in partial dilatation of a bronchial tube, which is observed occasionally in bronchitis. The absence or presence of signs peculiar to tubercles can alone determine the case |
| Presence of fluids in the bronchi. | Idem—smaller bubbles. | Clear, or somewhat more flat than natural. | Mucous r[illegible] | Bronchitis. Hæmoptysis with blood existing in the bronchi. | When the mucous rattle occurs in the larger bronchi it resembles the gurgling sound of a cavern; and reciprocally, when the cavern is small, the latter sound has great similarity to the mucous rattle. |
| Presence of fluids in the lesser bronchi. | Idem—bubbles of the size of large grains | Idem. | Subcrepitant rattle | Bronchitis. Œdema of the lungs. | This rattle closely resembles the crepitous, and does not differ from it essentially except in the greater volume of the bubbles and their inequality—a difference easily perceived by the [illegible] |
| Presence of sanguineous serosity in the vesicular cavities. | Formation and rupture of small bubbles in the air-cells. | More or less flatness. | Crepitant rattle | Pneumonia in the first stage. | The peculiar characteristic of this rattle is that it does not disappear after expectoration, and that the bubbles which constitute it are equal in volume, like that of the air-cells. It closely resembles the noise produced by rubbing stiff hair between the fingers, or that caused by tearing English taffeta. |
| Presence of air and fluid in a cavern of considerable size, or in the pleural cavity. | Formation of bubbles and their rupture at the surface of the liquid contained either in the cavern or pleural cavity. | Tympanitic sound in the portion corresponding to the air: flat or dull in that answering to the fluid. | Metallic tinkling of Laennec. Tinkling arising from bubbles of M. Beau. | Tubercular phthisis. Hydropneumothorax. | This sound proceeds, according to Dance and Beau, from the rupture of the bubbles of air as they arrive at the surface of the fluid contained in the cavern or pleural [illegible], in order that it should be heard, that the orifice by which [illegible] exist below the surface of the fluid. Whence [illegible] will be heard only in those cases of caverns [illegible] at their interior portion with the [illegible] the buzzing of a fly in a large [illegible] |
| Idem | Fall of drops of liquid adhering to the walls of the cavern, or the pleura, upon the surface of the effused fluid. | Idem. | Metallic tinkling. | Idem. | This sound closely resembles that produced by a drop of water falling into a decanter already containing a certain quantity of fluid. |
| Idem | Agitation of [illegible] liquid | Idem. | [illegible] | Idem. | |

### ABNORMAL RESONANCE OF THE VOICE THROUGH THE PARIETES OF THE CHEST.

| | | | | | |
|---|---|---|---|---|---|
| Normal [illegible] | [illegible] of the voice heard in the larynx and [illegible] the walls of the chest. | Clear. | Normal resonance of the voice. | Normal state. | This resonance is feeble generally over the lungs, the vibrations scarcely reach the ear. In the interscapular space, towards the root of the lungs, it is more marked, and sometimes resembles bronchophony. In persons who have a harsh voice, the resonance resembles more or less œgophony |
| [illegible] or [illegible] [illegible] | [illegible] bronchial tubes. The [illegible] ing to the fewer divi- [illegible] ations, a diminution [illegible] e number of the ob- [illegible] y of the morbid [illegible] the ear from the [illegible] | Flat or dull. In the dilatation of the bronchi, the sound will often be clear along the passage of the bronchi, and occasionally will be observed the sound of a cracked vessel when struck. | Bronchophony, bronchial voice, tubular voice. | Pneumonia in the second and third stages. Tubercles, with induration of a chronic character. Dilatation of the bronchi. | In pneumonia of the second stage, the sero-sanguineous matter becoming viscid and solidified, obstructs the air-cells. In the same affection, when arrived at the third stage, the air-cells are closed by pus, and in tubercles by the tubercular matter. When the tubercles form without the air-cells, bronchophony takes place in consequence of the obliteration of their cavity by compression from without inwards. It never changes its seat, whatever be the position assumed: it conveys vibrations to the hand when applied to the chest. |
| Obliteration of the air-cells in consequence of the compression of their walls by a pleuritic effusion of inconsiderable extent. | Resonance and breaking of the voice, during its passage, owing to the union of the pulmonary pleura. | Flat. Susceptible of being displaced. | Œgophony. Goat-like voice. Do. of Punch. Do. of that produced by blowing through a comb. Stammering. | Pleurisy, with moderate effusion. | If the pleuritic effusion be considerable, there will be no œgophony, from the fact that the thickness of the membrane resulting from the compression of the air-cells is too great to vibrate. In the majority of cases in which œgophony is heard, the hand applied to that portion of the thoracic parietes corresponding to the effusion, cannot perceive any vibrations of the voice |
| Partial [illegible] [illegible] cavern. | [illegible] | Similar to a cracked pot when percussed | [illegible] | An empty cavern from tubercular softening. | [illegible] of the walls of the cavern adheres to the part of the thorax, when the cavern is large, superficial, and its sides [illegible] The absence or presence of signs peculiar to tubercles will enable us to distinguish pectoriloquy resulting from a cavern from that produced by dilatation of the bronchi. |

### SOUNDS OBSERVED DURING THE ACTION OF THE CIRCULATORY CENTRE.

| | | | | | |
|---|---|---|---|---|---|
| Normal condition | A[illegible] | Flatness of the precordial region over a square surface of three or four inches. | Tic tac, or normal sound of the heart. | Normal condition. | The sounds of the heart may be more or less clear and loud, which depends upon the different degrees of thickness of the valves. In general, the sounds are more obscure in proportion as the valves are thicker. |
| [illegible] | A[illegible] | Flatness of sound over a greater extent than natural. | Absence or great feebleness of the sounds of the heart. | Pericarditis with effusion. Hydropericardium. Considerable hypertrophy of the ventricles. | In cases of pericarditis with effusion, the flatness of sound is susceptible of change, more or less marked, when the patient quits the horizontal position, and assumes the upright position. In hypertrophy, on the contrary, the flatness is unalterable. |
| Affections of the valves of the heart | [illegible] | This condition is often met with in chlorosis, where there is an augmentation of the volume of the heart with attenuation of the parietes; the dull sound will generally have greater extent than in the normal state. | [illegible] | Chlorosis. Nervous palpitations. | |
| [illegible] | [illegible] | The presence of the abnormal noises of the heart, has no influence in extending the flat sound, which is always proportioned to the volume of the organ. | Bellows sound. | Lesions concurrent to internal inflammations of the heart, such as adhesions of the valves to the walls, contraction of the aortic orifice, vegetations on the valves, sometimes hypertrophy of the heart, with dilatation. Copious hemorrhage. The presence of coagulated blood in the cavities. | In all these affections, there is a general element of the bellows sound, viz. the increase of friction. Thus, when the blood flows through the aortic orifice, which is contracted, the friction induced between it and the walls of the orifice, gives rise to the bellows sound. The same effect will be produced in those cases in which the blood flows back from the ventricles into the auricles. |
| [illegible] | [illegible] | Idem. | Saw and rasp sounds. | Organic contraction of the orifices of the heart, with ossification of the valves | |
| [illegible] | [illegible] | | Grazing sound. Friction do. New leather do. Scraping do. Saw do. Bellows do. | Acute pericarditis, or the same affection after it has contracted false membranes. | In general, all [illegible] sounds, which originate in the pericardium, are more superficial and more circumscribed than those which proceed from the interior of the heart. The former are observed almost exclusively in the precordial region, while the latter are heard below the clavicle, and even on the right side |
| Normal state of the heart [illegible] | [illegible] | | Metallic tinkling, or metallic clashing sound. | Palpitations in emaciated persons. | |

### ARTERIAL SOUNDS.

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| Normal [illegible] | [illegible] | | Flat sound | Normal state. | This sound is analogous to gentle and quick friction of one finger against the other, so as to produce a kind of lisp. |
| [illegible] | [illegible] | Flat, when the diseased artery increases in volume, for example, as in aneurism of the aorta. | Intermittent bellows sound. | Compression of the artery by a tumour. Aneurism of the artery. Varicose aneurism. Compression of the arteries of the pelvis by the gravid uterus. Osseous depositions in the arteries. | This sound may be produced by compressing the artery with the stethoscope. In aneurism of the aorta, besides the intermittent bellows sound, a very strong simple pulsation is heard at the place corresponding to the tumour, which is never observed in the normal state. |
| [illegible] | [illegible] | | Continuous bellows sound. Bruit de diable. Buzzing or modulated hissing of the arteries. | Chlorosis. Anæmia. | It has been noticed that those patients affected with chlorosis who have a degree of embonpoint, present the bruit de diable, while those who are thin offer the whizzing sound. Copious venesection will produce the former sound |

[illegible]: The organic state of the parts in which the sounds perceptible by auscultation are produced; the mechanism of these sounds, as well as those which the parts originating them offer when percussed, and the diseases in which [illegible]. The order in the exposition of these questions has been nearly indifferent to us. However, wishing to add greater interest to the study of auscultation and percussion, we have devoted the first division to the description of the [illegible] inspire the majority of those who study the table with curiosity to become acquainted with the phenomena which are the consequences of this organic state. It will be still more interesting to study and inform ourselves what sounds [illegible] sounds, the names of which, being more or less whimsical, present no interest.